INTRODUCTION TO PRACTICAL FARMING

FOR THE USE OF SCHOOLS

BALDWIN

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BY

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INTRODUCTION

TO

PRACTICAL FARMING.

PART I.

MANURES.

I. HOW LAND BECOMES EXHAUSTED.

1. Plants, like animals, require food. The food of plants consists, in addition to water, of two kinds of matter—namely, *fixed* and *volatile*. The fixed matter is made up of ten or twelve substances, derived solely from the soil; and the volatile of four bodies derived by our cultivated crops partly from the air and partly from the soil, and which fly away into the air under the action of heat, and are, in consequence, called *volatile*. Many wild plants have the power of growing on hard rock destitute of any volatile matter; but cultivated plants, such as the cabbage, require for their full growth a soil containing such matter. We increase the quantity of volatile matter in the soil by laying it down to grass; and by the application of farm-yard manure, of peat, and of other vegetable sub-

stances. The quantity of this matter in the soil varies very much. Rich gardens contain a great deal of it, and it may be said that, with certain exceptions, the amount required for the growth of crops should increase with their luxuriance and delicacy. Of farm crops, the cabbage and the grasses require it in large quantity. The cabbage should therefore be grown in rich ground. Of the grass family of plants, there is none which luxuriates in a soil rich in combustible matter, or matter that can be burnt away, so much as Italian rye-grass, of which more will be said further on, and of which enormous crops are obtained by skilful management on reclaimed bog and moor. The fixed constituents of plants, also called the *ash* and *mineral* constituents, are invariably obtained from the soil. A soil deficient in any one, or in more than one of them, is barren. They exist in very different proportions in the different families of crops. The composition of the same sort or variety of crop is pretty constant.

2. We see, then, that a given weight of any crop must take out of the ground a quantity of fixed or ash constituents. If the crop, or part of it, be sold off the farm, it is evident the total quantity of the ash constituents in the soil must be lessened. If the quantity of these constituents sold off were returned to the soil in manure, it would not suffer any deterioration; but if crop after crop be sold without any manure, it is evident the supply of ash constituents will become less and less, and the yield may be so far reduced that the crop would not pay. This actually occurred in some of the Slave States of America, where the land was so reduced in condition by crops of tobacco following each other year after year, that it had for a time to be left untilled, and abandoned to a state of nature. It is occurring at the present moment in other parts of America, in parts of the Australian colonies, and elsewhere.

3. Before we can apply the knowledge of the foregoing facts to practical agriculture, it is necessary to explain that only a very small part—rarely more than the one-hundredth part—of the soil is at any one time in a state to afford food to our crops, the bulk of the constituents being locked up in the structure of the soil in an unavailable condition—that is, in such a state that the plants cannot use it. The stones in the soil may contain the same substances as the soil itself, yet we know that crops can feed on the soil, but not on the stones. In the course of time, and under the influence of air and moisture, the constituents of the stones become gradually liberated, and thus made fit food for plants. The process is slow, but it is continuous. The stones in our buildings crumble, and so the stone and particles of the soil are gradually worn down, and their constituents converted into plant-food. An interesting illustration of this principle is afforded in the observation that the removal of stones from poor land, when they appear to be in excess, often does harm. The farmer, in ignorance of a better explanation, says the removal of the stones makes the land cold; the true explanation is to be found chiefly in the circumstance that the stones, by the wearing down of their surface, afford a certain amount of food to the crop.

4. If we apply the principles which we have so far explained to the occupiers of land in remote or badly-farmed districts, we shall see that the soil, having for ages been made to bear crops without adequate manure, has been reduced to a poor state. Dairy produce, young stock, grain crops, and the potato, have taken out of the land a good deal of its most valuable ash constituents. The potato contains a large amount of potash, and this substance, though abundant in argillaceous clay, is contained in very small quantity in the light lands in the hands of many of our small farmers. Recent research tends to show that the potato disease

is mitigated by the application of a manure containing potash.

5. Of all the component parts of our soils, phosphate of lime is most liable to become deficient. It exists in ordinary land, especially in light land, in very small quantity; yet it is contained in grain, in the bones of animals, in dairy produce, and in every species of produce disposed of by the farmer. It has been shown that an enormous quantity of this substance is annually taken out of the soil of this country, —that it is essential to pay proper attention to its restoration, and that a vast number of farms has been reduced to a state bordering on barrenness by the ruinous system hitherto pursued.

6. That the system of agriculture followed in many parts of the country has reduced the fertility of the soil to a very low condition is known to all experienced persons, and is made plain by reference to the modern practice of applying artificial manures. Under our direction, an application of 2 cwt. per statute acre of the manure now commonly sold at 6*s.* per cwt. under the name of *superphosphate* of lime, containing 48 lbs. of phosphate of lime, increased the yield of turnips on poor light land by nine tons. We have seen similar results on poor light land on the chalk formation in Wiltshire. It will, then, be asked—How comes it that our soil has not been reduced to a state of absolute sterility, if it has been for ages subjected to the process of exhaustion we have described? The answer is, that the total quantity of its constituents sold off in any one year is very small: in some cases there has been a counter-process of restoration, in the application of sea-weed, of fish, and other substances; and plant-food has been liberated by the wearing down of the stones and particles of the soil. When the quantity of matter added or liberated in this way equalled the quantity sold off, the farmer did not experience any deficiency in his crops. When the demand on the soil

exceeded the quantity of plant-food liberated, he rested his land. Sometimes it was left to cover itself with natural herbage; sometimes it was rested for a year and fallowed, which means that it was during this year repeatedly ploughed and harrowed, to promote the action of air and moisture in liberating its constituents. It is to be remembered, too, that one of the leading features of modern agriculture is the liberal use of artificial or purchased manures; and that in a great many instances the farmer has seen the necessity of using marl and composts of various kinds.

7. The lamentable consequences likely to arise from a neglect of the great law of exhaustion, which we have endeavoured to expound, have been brought home to us by the Irish famine. It is a matter of scientific certainty that the fearful havoc committed by the potato disease in Ireland was largely owing to the fact that her soil had been reduced by the continued growth of the potato crop, and of other crops, without an adequate return in manure.

II. FARM-YARD MANURE.

8. The great means of preserving our soil in a productive state has been the collection and preservation of farm-yard manure, which consists of the fecal and waste products of the farm. The consideration of this substance, therefore, demands our best attention.

9. The cow-house, stable, and piggery should be carefully cleaned out at least once a day, and the waste carried to the manure-heap, the site and management of which do not receive adequate attention. In small farm districts it too frequently happens that the manure is accumulated in front of the door of the dwelling-house, giving rise to most offensive effluvia, which often produce disease. Again, we often see small heaps of manure lying loosely here and there about

the house and offices, by which its substance is wasted, as we shall now explain.

10. The food of plants is supplied by the mineral kingdom. Animal or vegetable bodies deprived of life soon begin to decay, by which they go back again to the inorganic or mineral kingdom, and become fit to supply the wants of plants. A heap of farm-yard manure, exposed to air, moisture, and a certain degree of heat, decreases in bulk and weight, its combustible constituents being gradually converted into volatile substances, and its ash constituents being liberated and left behind. If the manure be under cover, the diminution in its bulk will be very slow, but it goes on nevertheless, the progress of the change depending on the quantity of air and moisture present, and on the degree of heat. Under the influence of these three agents, nothing would ultimately remain of the manure, even if under cover, but its ash constituents.

11. In the manure-heap, this change goes on very slowly. The farmer can accelerate or retard it by varying the quantity of air and moisture. For example, when we want the manure to rot slowly, we compress the heap, and thus exclude air. If the season is advancing, and we have reason to fear the manure is not rotting fast enough, we turn the heap, so as to let more air into it. Sometimes it is turned twice in the season; but this, under ordinary circumstances, should be avoided, as the extra labour is unnecessary. All the valuable products of decay in a manure-heap are soluble in water; hence it is necessary to prevent the rain from washing them away. The thick, black liquid, which is seen trickling away from the manure-heaps of so many of our farmers, contains the very essence of the manure.

12. As farm-yard manure is made up of the voidings of the farm animals, and of the materials used in littering them, it is evident that, when properly made, it contains all the mineral constituents taken

out of the ground by crops, except what is sold off. It may be regarded as the most perfect of all manures; for it contains not only every mineral substance found in plants, but also a great deal of volatile matter, derived from the air by the plants from which it is produced. In addition to the materials of which farm-yard manure is made up, it is desirable to collect into a *compost-heap* weeds and refuse substances.

13. A cow fed in the house gives about a ton of farm-yard manure per month; two cows, house-fed throughout the year, or four, during the winter half year, would therefore produce twenty-four tons, which would manure an acre of potatoes or of roots.

14. When manure or compost-heaps decay, bad smells are, as already explained, generated, which are most injurious to the health of the people. A manure or compost-heap of any kind should not, therefore, be placed in front of the dwelling.

15. A proper receptacle should be formed for the manure-heap, and, if possible, it should be placed on the north side of the farm-yard. With the view of economizing labour, it should be as near as possible to the byre, and stable and piggery; and, for obvious reasons, it should be as remote as possible from the dairy and dwelling-house. It should also be on level ground; for if placed on sloping ground, there would be a great loss of the liquid, which would make its way down the slope; and if placed in a hollow, it becomes too much saturated with rain-water.

16. Many farmers have a slovenly and wasteful practice of allowing the manure of the byre, stable, and piggery to lie for days and weeks in small loose heaps, exposed to the deteriorating influence of air and rain.

17. To avoid this, the manure-heap should be occasionally dressed. If surrounded by a wall, it can easily be kept tidy. In this case the manure from the several offices should be scattered over the

heap. On small farms, where labour is abundant, the manure-heap should be covered occasionally, and particularly in summer, with a layer of peat, vegetable mould, or earth, to absorb ammonia, and other valuable products of decomposition. When peat exists on the farm or in the neighbourhood, it is one of the best substances to be used for the purpose: the fecal matters of the animals induce the decay of the peat, and thus convert it into good manure. In the absence of peat, the following plan of making manure has been successfully practised on small farms. The site of the dung-heap is made level. There is no channel surrounding it. Earth is placed round about the heap as soon as any manure collects in it; and when this earth is saturated with the oozing from the manure, it is shovelled on to the top of the heap, and fresh earth put in its place; and this, when saturated, is again put on top of the fresh dung added. The liquid manure of the cattle is received in a barrel, and regularly poured on the whole. In this way the earth itself is converted into a valuable fertilizer, not only by the absorption of some of the products formed by the decomposition of the manure, but also by the conversion of some of its own dormant constituents into active food for plants.

III. LIQUID MANURE.

18. The liquid voided by the domestic animals is commonly called liquid manure, a name which is also given to the drainage of dung-heaps, and to town sewage.

19. The most profitable way of disposing of this substance is by causing it to be absorbed by the solid or farm-yard manure. For, firstly, as the liquid and solid excrements of animals differ in composition, a perfect manure is obtained when they are mixed together. Secondly, as the liquid soon begins to fer-

ment, it promotes the decomposition of the solid manure. Thirdly, as a good deal of the water of liquid manure is evaporated, the cost of conveying it to the land is kept as low as possible.

20. When liquid manure is disposed of in this way, the litter is made to absorb a good deal of it; the quantity so absorbed depending on the quantity of litter used. A channel or drain should convey the remainder to a receptacle, which, on a small farm, may consist of a barrel or two, or distillery vats. The large farmer must build a tank of brick or stone. It should be well lined with cement inside, and drained all round, to prevent the water that would otherwise accumulate in the surrounding soil from pressing in the wall. Some or all of the liquid that accumulates in the tank should be occasionally pumped over the manure-heap; and any of it that cannot be disposed of in this way should be applied to the nearest field of grass. Rain-water should not be permitted to enter the liquid-manure tank, especially in winter, as it does not pay to convey it to the land.

IV. ARTIFICIAL MANURE.

21. An *artificial manure* is, literally speaking, one made by art or by the hand of man, such as the several kinds of superphosphate. At present the title is synonymous with concentrated manure, and includes such natural products as Peruvian guano, and all substances that contain in a small bulk a large amount of one or more of the most important of the elements of manures.

22. The reader will understand from what has been already explained, that, in the practice of modern agriculture, phosphate of lime is constantly withdrawn from the soil, and must be restored by applications of manure. The substances used for this purpose are

farm-yard manure, which we have already considered, and bones, guano, and other concentrated fertilizers, of which we have now to treat.

23. Manures, like bones and superphosphates, which depend for their efficacy chiefly on phosphates, are called *phosphatic manures*.

24. Phosphate of lime being insoluble, or nearly so, in water, but capable of being converted into biphosphate of lime (called also superphosphate of lime), which is soluble, by sulphuric or muriatic acid, Liebig suggested the propriety of bringing about this change in bones and other phosphatic manures "by dissolving" them in sulphuric acid. This suggestion laid the foundation of the system of manufacturing the class of artificial manures called "superphosphate," which forms one of the most interesting features of modern agriculture.

25. In chemical language, the terms biphosphate and superphosphate are synonymous; but the term superphosphate, as commonly used by farmers and manure vendors, is applied to the artificial manure produced when bones or other phosphatic materials are acted on by acid.

26. A great variety of phosphatic substances may be used for the production of superphosphate. At first, bones were most extensively used; but science has placed several phosphatic bodies of a fossil or mineral character within our reach, such as coprolite, which is found in Cambridge and Suffolk, apatite, and some species of guano which in the course of ages have been deprived of their volatile matter and reduced to a fossil or fossil-like state. In coprolites the phosphate of lime is locked up in a state in which it exerts little influence on the crop to which it is applied. The degree to which the phosphate of lime of guano is available depends on the nature of the guano. In Peruvian guano it acts immediately; while in those kinds of guano which have been reduced to the fossil

or fossil-like state it is so slow in its action that, like coprolites, the application of these guanos does not pay.

27. It is believed that biphosphate of lime is equally available or active, no matter from what phosphatic material it is derived. And accordingly, the intelligent manufacturer uses, for the production of this compound, the substance in which he can buy phosphate of lime at the cheapest rate.

28. If we mix soluble phosphate of lime with calcareous matter, we shall find that it is converted into a state more or less insoluble. The same change takes place when superphosphate is applied to land containing calcareous matter. And this being so, it may be asked, why do we go to the expense of making superphosphate. In answer to this question we have to state, that the particles of the phosphate of lime are more easily dissolved and conveyed into plants in the one case than in the other. An explanation of this is, that the atoms affected by chemical changes are extremely minute, and that the more finely divided a body is the greater surface it presents for the action of water and other agents used by nature for dissolving the food of plants.

29. The greater part of the superphosphate now in the market is made from mineral phosphate. The manure so made is called "mineral superphosphate" to distinguish it from superphosphate made from bones. It follows from the explanation already given, that in mineral superphosphate, all, or as much as possible, of the phosphate of lime ought to be converted into biphosphate. If this be not done, the farmer puts into his land a quantity of phosphatic material which may not be worth the cost of carriage. In other words, the farmer should use what we may call a high class superphosphate: such a manure would contain 25 or 26 parts of biphosphate of lime, and not more than 2 or 3 parts of phosphate of lime, in every 100 parts by weight.[1]

[1] It will be understood from the text that the value of mineral superphosphate depends almost entirely on the biphosphate of

30. Superphosphate made from bones contains volatile matter, and is capable of affording from one to two per cent. of ammonia.

31. Superphosphate, in common with all phosphatic manures, is better adapted to light than heavy soils. It produces the greatest effect on roots, and is especially good for turnips. It is the basis of all the mineral manures sold under the name of mangold-manure, turnip-manure, and potato-manure, the other ingredients being ammonia, and in some cases potash. There is no branch of the farmer's business so little understood as the proper proportions in which to mix these ingredients. In most cases, artificial manures are made up by manure vendors and others whose knowledge of the wants of crops is very limited.

32. Next to phosphate of lime, potash is regarded as the most important of the fixed constituents of crops. Several manufacturers add it to superphosphate. Potash is most useful for potatoes, beans, and clover. According to some, the cheapest source of potash in the market is a German salt called kainits. We have occasionally applied it with advantage to potatoes and beans at the rate of four cwt. per statute acre. We have found that a crop of clover grown on the same land afterwards, in the ordinary course of cropping, has been greatly benefited by the potash.

33. *Guano* is one of the most important concentrated manures we possess. It is supposed to have once been the excrements of sea-fowl which have accumulated in some parts of the globe.

34. There are several kinds of guano in the market. When guano is subjected to the influence of heat, air, and moisture, it undergoes decomposition, like all

lime it contains. Superphosphate always contains sulphate of lime or gypsum, which is a product of the manufacture, as the reader will learn when he studies agricultural chemistry. The more biphosphate of lime a superphosphate contains, the greater also the quantity of sulphate of lime present.

other substances of animal and vegetable origin. In the Chinca Islands, from which the principal supply of Peruvian guano used to be obtained, no rain falls, and one of the three conditions essential for decomposition—namely, moisture—is absent; hence it contained a large quantity of volatile matter, which was capable of affording 15 or 16 per cent. of ammonia. It also contained about 25 per cent. of phosphate of lime, and $3\frac{1}{2}$ per cent. of potash. The supply of guano in these islands has been all used; and the guano now sold under the name of Peruvian comes from the mainland, contains less ammonia, and is more variable in composition than Chinca Island guano. Good Peruvian guano now contains about 10 per cent. of ammonia. Being so variable in quality the Peruvian government or their agents should mix it in large quantities, so as to produce a manure of uniform composition.

35. Manures, like Peruvian guano, which are purchased chiefly for their ammonia or nitrogenized matter, and those, like sulphate of ammonia, which depend solely for their action on this substance, are called *ammoniacal manures*. It is worthy of remark here, that all these manures not only afford their own constituents as food to the crop, but aid in dissolving the insoluble fixed constituents of the soil.

36. It is not safe, therefore, to use pure ammoniacal manures frequently on poor light land without farmyard or some other manure which would add fixed matter to the soil. We have for experimental purposes reduced light land to a state of temporary barrenness by repeated dressings of manure of this class.

37. Peruvian guano is applied with advantage to all our cultivated crops. It may be stated generally, that phosphatic manures are best for roots, and ammoniacal manures for corn and grass.

38. Peruvian guano and ammoniacal manures produce a better effect on strong clay than on light or

sandy land. As a topdressing for corn and grass, especially in spring, Peruvian guano produces a good effect on a great variety of soils, and under a great variety of circumstances. It is applied to these crops at the rate of from 1 to 2 cwt. per statute acre. Numerous experiments have shown, that when from any cause corn is not thriving, an application of $1\frac{1}{2}$ cwt. of this manure, at a cost of about 1*l.*, increases the value of the crops from 30*s.* to 2*l.* On pasture land it encourages, in common with all ammoniacal manures, the growth of the stronger grasses, such as cocksfoot; and by enabling plants to continue growing longer, retards both the harvest and the haymaking. It is seldom applied for roots on light land; but many farmers consider it superior to superphosphate on clay land, and equal to it on clay loams, but since the supply of guano from the Chinca Islands became exhausted, we introduce ammoniacal matter into mixed manure in the shape of sulphate of ammonia and nitrate of soda for these crops. On the latter class of soils we have found a mixture of Peruvian guano and superphosphate of lime give excellent results. When Peruvian guano is applied alone for roots on medium soils, the quantity used is about 4 cwt. per statute acre. On sound rich ground which yields a heavy crop an additional cwt. may be applied.

39. Sulphate of ammonia and nitrate of soda are the purest ammoniacal nitrogenized manures in use. Sulphate of ammonia is extracted from the liquor of gasworks. Nitrate of soda is met with as a natural product in South America and elsewhere. Neither is applied alone for roots or potatoes; but they enter in moderate quantity into mixtures for these crops, and are used alone or in mixtures for corn and artificial grass. The propriety of using one in preference to the other, as a source of nitrogen, depends chiefly on the cost, and to a certain extent on the nature of the soil and the crop, as explained elsewhere.

40. In Patagonia, in several parts of Africa, and in other parts of the globe, guano is also found; but as rain falls in all those countries, the combustible matter has in the course of time undergone decomposition, its ammonia has been dissipated, and there remains only the phosphate of lime—a circumstance which explains why this species of guano is often called phosphatic. A good specimen of phosphatic guano may contain as much as 70 per cent. of phosphate of lime. Several kinds of it are at present in the market; but as their phosphates are in the insoluble state, they are seldom applied directly by the farmer, and are used in the manufacture of superphosphate of lime.

V. LIME.

41. *Lime* is the most important mineral manure we possess. It produces several useful effects in the soil.

42. In common with all the fixed mineral constituents of plants, lime must be present in every fertile soil.

43. Some soils contain acid substances, which keep them in a sour and comparatively infertile state. Lime combines with and neutralizes these acids, and thus fits the soil for growing good crops.

44. In other cases, infertility or barrenness in soils arises from the presence in them of noxious compounds, such as salts of iron and copper; and lime has the power of decomposing these compounds, and rendering them harmless.

45. Lime promotes the decay of volatile or combustible matter. Experience tells us that applications of lime diminish the quantity of this kind of matter in the soil. As the quantity of vegetable matter in the ground increases, so does the necessity for applying lime. This explains the old saying, "The more dung, the more lime." Peaty soils, which contain a great deal of inert vegetable matter, are much improved by quick-lime.

46. Lime helps to liberate the fixed constituents of the soil. If we mix lime with ground granite, or with pulverized clay soil, we shall find, after a time, a quantity of potash and soda liberated: in other words, lime converts some of the dormant fixed mineral matter of the soil into active plant-food, or, as it were, forces the soil to give up to the crops some of its latent constituents. This effect is produced much more speedily by quick or caustic than by mild lime (carbonate of lime).

47. This partly explains why lime produces the greatest effect when first applied to a field, and that the oft-repeated use of lime without any other manure, by stimulating the soil, would ultimately end in rendering it sterile. Hence the converse of a proposition stated above, which says that the more dung, the more lime, is also true—namely, the more lime we apply, the greater the necessity for dung—a notion well expressed in the old saying, that "the use of lime without manure, is sure to make the farm and the farmer poor."

48. If we mix quick-lime with Peruvian guano or well-rotted dung, a peculiar smell is felt, caused by the escape of ammonia. Hence, lime should never be permitted to come into contact with either of the manures named, or any other manure containing ammonia. When farm-yard manure and lime are applied to the ground in the same year, the lime should be used before or after the dung.

49. The state in which lime is applied to land varies with the quality of the land and other circumstances. The common practice is to cart the lime to the field, make it into a heap or heaps, cover it over with a little earth, and allow it to fall into powder, or to slake spontaneously; after which it is evenly spread on the land and harrowed in, or otherwise worked into the ground.

50. The slaking of lime is a chemical process. The lime absorbs and combines with moisture, forming

hydrate of lime, and causing the development of heat and a swelling of the lime-shells, which soon crumble to powder. The finer the state of subdivision into which the lime falls, the more completely it is distributed through the soil, and the more thorough and uniform its action.

51. When the lime is applied as above described, it absorbs moisture from the air, and is said to slake spontaneously; and, for general purposes, there is no better way of applying it. Some farmers who use much lime make it into a large heap or heaps, and hasten the slaking process by pouring water upon the mass. If applied immediately after slaking in this way, lime is quickest in its action, as it is in the caustic or hydrate state.

52. Sometimes, again, the lime is made into a compost with earth or peat, in which state its action is slower than in either of the preceding states.

53. It is evident that the propriety of applying it in one or other of these three states depends on the nature of the ground; also, on whether we wish its action to be quick or slow. When the soil is light or sandy, and deficient in vegetable matter, and its texture open, it is recommended to apply the lime in a state of compost, which contains the lime in the mild state, and also contains other materials in which these soils are deficient. It is said that lime, when applied to light land in the caustic state, encourages the growth of red poppy and other weeds. On the other hand, lime should be applied in as caustic a state as possible to all soils containing much vegetable matter, such as peat and moss, as well as to clays, moors, and other soils undergoing reclamation, and to all soils containing injurious substances, such as the salts of iron.

54. The application of lime to clay-land renders the soil more friable, and, at the same time, converts a good deal of its dormant constituents into the active state.

55. An excess of moisture in the soil prevents lime from producing its full effects. Hence, wet lands require a greater quantity of lime than those which are naturally dry, or those which have been made so by drainage. In the permanent improvement of clay land, or wet ground of any kind, lime should therefore be applied after drainage. For the same obvious reason, good farmers put lime upon the ground in dry weather.

56. Lime is applied with advantage to all crops except flax.

57. There is a difference of opinion among farmers as to the crops to which it is best to apply lime; some contend that it should be applied for roots, while others prefer to apply it for grain. Regard being had to its various functions, it cannot be expected to produce its full effects in the year in which it is put upon the land. If, therefore, the farmer has good reason to suppose that one crop in the rotation requires lime more than the rest, it should, if practicable, be used a year before that crop.

PART II.

THE CROPS TO GROW, AND HOW TO GROW THEM.

I. THE SEVERAL SYSTEMS OF CROPPING.

58. THE farmer has found, from practical experience that some of his crops, especially clover and turnips, become diseased, or fail altogether, if grown too often on the same soil, and that this is prevented by growing them in regular rotation or succession. The order of succession varies with the soil, market, and other circumstances.

59. Scientific men have given several theories of the advantages of growing crops in rotation.

60. It is found that about twelve mineral substances are required for the growth of farm crops, and that these minerals exist in very different proportions in the different families of those crops. Thus, while a crop of wheat abstracts from the land 137 lbs. of silica and 34 lbs. of potash per acre, a crop of beans carries off 15 lbs. of silica and 134 lbs. of potash. It was reasonable, therefore, to suppose that if wheat were grown consecutively on the same ground, without an adequate return of silica in manure, the supply of this substance in the soil would become so far reduced as to render it incapable of producing a remunerative crop of wheat: and if, instead of wheat, beans were

continuously grown for a number of years, the quantity of potash in the soil would soon become too limited for the wants of the bean crop. It was then suggested that the advantages of alternating these two crops arose from the difference in their chemical composition; and that crops should be alternated in accordance with the analysis of their ashes. This constitutes the celebrated *mineral* theory of the rotation of crops.[1] To comprehend the full force of this theory, it is necessary to bear in mind that plants derive all their mineral constituents from the soil, and that the growth of plants is greatly dependent on the state or condition in which these constituents exist in it. For illustrating this, we will take root and corn crops. By the thorough exposure of the soil to the air and its influences during the cultivation of root crops, a large quantity of silica becomes liberated, which is not required by that crop, and remains in the soil for the nourishment of the grain crop, which requires soluble silica in large quantity.

61. Plants differ very much in their habits of growth; and this affords an additional reason for alternating

[1] The word mineral has not been always used in the same sense by agricultural writers. Those who use it in the sense stated in the text would restrict its application to the fixed constituents of the soil. In its wider and more correct sense, it is applied to metals, rocks, and other substances met with in the mineral kingdom; and includes carbonic acid, water, and ammonia, which are component parts of minerals. Much confusion of thought has also resulted from the way in which the words organic and inorganic have been used. An organic body is, properly speaking, the product of living organism. Starch and sugar, fatty matter, gluten and other flesh-forming materials are organic. Matter which is not the product of living organism is inorganic. All mineral matter is inorganic. Organic matter, when it decays, is converted into carbonic acid, water, and ammonia; and thus goes back to the mineral kingdom, in which state alone it can become food for our crops. All organic matter is volatile; that is, it is capable of being driven off by heat; but all volatile matter is not organic.

them. Thus, the corn crops possess a small system of foliage; root crops, on the contrary, have large leaves, which take in from the air carbonic acid and watery vapour, which help to build up the combustible part of their substance. In the same way the grasses which have a large system of leaves, take in a considerable quantity of those materials from the air; and, as is well known, by their death and decay the quantity of vegetable (combustible) matter in the soil increases. It is a common practice to allow poor land to remain in grass for a few years, with the view of enriching it in vegetable matter.

62. Again, the roots of crops penetrate to different depths into the soil, and feed on different parts of it. Root crops—especially parsnips and carrots—send their roots to a great depth into the soil. Grain crops send some of their roots down to a considerable depth, but throw out a great many lateral roots. The natural grasses are essentially surface-rooted plants. Red clover sends its strong tap-root to a great depth. It is manifest that the exhaustion of the soil must be deferred by growing these crops in succession.

63. One of the greatest practical advantages of the rotation of crops is, that it enables us to keep the land clean. Green crops, owing to the tillage they receive, are called *cleansing* crops. On the other hand, if we grow three or four crops of corn in succession, the land is sure to be overrun with weeds.

64. Beans and wheat have occasionally been grown alternately on strong clay land.

65. A three years' course of cropping has been occasionally followed by some farmers, the order of succession being—

1st Year.—Root crops manured—such as turnips, mangold wurtzel, &c.
2nd Year.—Grain crops, laid down with grass and clover seeds.
3rd Year.—Grass, for house-feeding cattle and for hay.

This course may be practised on spade-labour farms. There is a very large portion of the farm under crops for feeding cattle, which recommends it to small holders who adopt the system of soiling or house-feeding cattle. The preparation of grass land for roots increases the labour very much; and besides, in this course, the same crop comes round too often on the land. We have seen this system once adopted as a means of enriching a thin poor clay, and preparing it for another course of cropping.

66. In the Norfolk four-course rotation, which may be said to be the basis of most of the systems of cropping in use, the order of succession is—

1st Year.—Root crops manured.
2nd Year.—A grain crop, laid down with grass and clover seeds.
3rd Year.—Artificial grass.
4th Year.—Grain alone.

In the drier and warmer districts of England, such as the eastern, southern, and midland counties, wheat follows artificial grass, which is generally clover. In the colder and more humid climates of the north of England, as well as of Scotland and Ireland, oats usually succeed grass.

67. One fourth of the land is under grass; and one fourth manured every year. It was by means of this rotation, and by feeding sheep on the turnips where they grew, that extensive tracts of poor light soils in Norfolkshire (from which this rotation takes its name) have been converted into most productive farms. The 'golden foot" of the sheep consolidated the land, and their droppings enriched it.

68. It has been found that clover will not bear to be repeated on the same land every fourth year. Turnips, too, when repeated on the same land every fourth year, become subject to a disease called *anbury;* and even the corn crops become more precarious when repeated on the land too frequently. Flax cannot be

introduced oftener than once in eight years. Practical experience teaches that this crop sickness is mitigated by efficient tillage, and by the application of lime. It is also greatly mitigated, if not prevented, by keeping the same crop off the land as far as possible. Now, we can easily accomplish this in any rotation by alternating the several kinds of roots, grasses, &c., among themselves. Thus, if in the four course system we have, this year, turnips in one part of a field, and mangold in another part, this time four years, when the same field is under roots again, the mangold should be put where the turnips are this year, and *vice versâ*. In this way, turnips are not grown on the land oftener than once in eight years. In the same way, by alternating clover and rye-grass, the former comes round on the same land only once in eight years; and so on of other crops. This principle may be carried out still further. For example, the root crop field may be divided into three parts, and by shifting the turnips from one part to another, they would recur on the same land only once in twelve years; and, in the same way, by dividing the grass field into three sections, clover would not come round on the same soil oftener than once in twelve years. The farmer who tills well, and manures fairly, does not suffer from clover-sickness or turnip-sickness, when these crops are not repeated oftener than once in eight years; but if, from poverty of soil, or any other cause, the crops show signs of degeneracy, the rotation may be extended in the way pointed out.

69. On one of the farms under our management we carry out the foregoing principle as follows:—The root-crop ground is pretty evenly divided between mangolds and turnips. The mangolds are manured with good farmyard dung, and the turnips with artificial manure, or with a mixture of farm manure and artificial manure, if any of the latter remains after manuring the mangolds. The turnips are followed by barley,

which gives an even sample; and with the barley is sown clover. The mangolds are followed by wheat or oats, with Italian rye-grass seed. By alternating mangolds and turnips, when they come round again, the turnip crop recurs on the same soil only once in eight years.

70. On that land, barley after roots, well manured with dung, would lodge; but after artificial manure, it never lodges.

71. The Italian rye-grass, which requires rich land, does far better after farmyard, than after artificial, manure.

72. By allowing the grass to be unbroken a second year, the Norfolk is converted into the Northumberland five-course, in which the crops follow in this order—

1st Year.—Root crops manured.
2nd Year.—Grain, with the seeds of artificial grasses.
3rd Year.—Grass.
4th Year.—Grass, 2nd year.
5th Year.—Grain, generally oats.

This rotation has been extensively followed in the county from which it takes its name, and in the more humid parts of England. The first year's grass is usually mown and the second pastured. The second year's grass is never as heavy as that of the first; but the cost of the former per acre is less, as the seeds, which are expensive, fall on one year's grass in the four-course rotation. Now, the relative profitableness of the first and second year's grass depends principally on the soil and climate. In a humid climate like that of the north of England, and many parts of Ireland, the second year's grass does very well on medium soils for pasturage. It is not suited to small farmers who house-feed their stock, as the second year's grass is not as profitable for soiling as the first: and if they require pasture for the cattle, the best plan, on the majority of spade-labour holdings, is to keep

a part of the farm in permanent pasture for the purpose, and to put the rest of the land under a rotation which would allow the land to remain in grass only one year. On larger holdings, well fenced, the first course answers well.

73. By allowing the land to remain three years in grass, we get the following six-course :—

1st Year.—Root crops and potatoes, manured.
2nd Year.—Grain, laid down with grass seeds ; the grain crop in this case being almost invariably oats.
3rd Year.—Grass, say for soiling or hay.
4th Year.—Second year's grass, for pasture.
5th Year.—The third year's grass, also for pasture,
6th Year.—Oats.

74. In this rotation one-half the land is in grass, one-sixth in roots and potatoes, and one-third in grain. It would answer very well on lighter land than that for which the five-course is adapted, and more especially for poor, light, and hill-side farms, on which the rearing of young stock is the principal object ; that is, land which is too poor to bear two grain crops in five years. The roots of the grasses enrich the poor land and prepare it for a crop of corn. On hill-side farms a rotation of this kind, which lessens the area under tillage and gives a large proportion of grass for the rearing of sheep and horned cattle, answers very well. The carting of manure and crops in hilly districts is very expensive ; and, besides, the climate of those districts is better adapted for grass than for any other crop.

75. By allowing the land to remain in grass a fourth year, we get the seven-course ; and so on.

76. The following six-course rotation has been extensively followed in East Lothian, whence it takes the name of the East Lothian Six-Course :—

1st Year.—Root crops manured, generally turnips.
2nd Year.—Grain, say barley, laid down with grass seeds.
3rd Year.—Grass.
4th Year.—Oats.
5th Year.—Potatoes and beans, manured.
6th Year.—Wheat.

77. For the first four years the order of succession in this rotation is the same as in the four-course. The oat stubble is then tilled for potatoes and beans, which prepare the land well for wheat. One-half the land is under corn, and each corn crop comes in the place best adapted for it. We have the most valuable farm-crops in this rotation. One-third of the farm is manured every year, namely, one-sixth for roots, and one-sixth for potatoes and beans. The recurrence of the same crop on the land only once in six years prevents crop-sickness. This is essentially a tillage rotation. It is practised in some of the best cultivated districts of Scotland. Probably the average rent of land in those districts is higher than in any other part of the United Kingdom.

78. There are many other rotations in use, but those which we have described may be said to embody the principles of all.

79. The introduction of artificial manures, and the use of improved modes of cultivation, have enabled us to modify our systems of cropping very materially. The principles we have expounded, and the systems we have explained will, however, continue to be the foundation of improved farming, especially on all the light and medium tillage lands of the country.

80. The crops most extensively grown are potatoes, root-crops, green crops, grain-crops, forage and herbage plants, and flax.

II. THE POTATO.

81. The potato is raised by every farmer for his own family, the area put under the crop for the purpose depending on the size of the family, and the extent to which the potato enters into their diet. To supply the wants of an ordinary family, half an acre of ground is required. When well manured, this will yield at least three tons of potatoes fit for table, and a

ton of small ones for feeding pigs and cows. The potato grows in all sorts of land. A rich loamy soil gives the heaviest return; the soundest crop is obtained from dry land; and marshy or boggy ground gives the best potatoes for seed. It is almost invariably the first crop planted on bog or waste land undergoing improvement.

82. The potato admits of being planted after any other crop. Many farmers plant it on lea. The ground is deeply ploughed in spring, the grass being completely buried by a "skim" coulter or one-horse plough; the crests of the sods broken down by the grubber or harrow, or both; the ground ridged or drilled by the double-mould board plough, manure spread in the drills; and the "sets" (cut potatoes) laid over it, ten to twelve inches from set to set, and the whole covered by splitting the drills again with the double mould-board plough. When the plants appear at the surface they are moulded; and as they grow up the clay is again raised from the furrows against their stems. The weeding of the crop, afterwards, should be properly attended to.

83. On cottier and small farms, the lea may be dug deeply as early as possible; when the planting season arrives the surface should be levelled with the spade or harrow, and the manure carted out and deposited in rows; a straight trench opened with the spade to the depth of four inches, the manure deposited in the bottom of this trench, the sets placed over it at intervals of ten inches or a foot, and both manure and sets covered with the clay lifted out of another trench marked off with a garden-line about twenty-four inches from the first. In this second trench manure and sets will in turn be deposited, and covered in with clay taken from a third trench; and so on. Or, drills may be opened with the shovel twenty-eight inches wide, farm-yard manure spread in the hollows of these drills, the sets placed on it

at from ten inches to a foot asunder, and both manure and sets covered by splitting the drills. The after-culture consists in digging or grubbing between the rows, to loosen the ground, in keeping down weeds, and putting earth against the stems of the plants.

84. In the ordinary course of cropping land under rotation, the potato usually follows lea oats, and occupies the same place in the rotation as root-crops. In this case the ground is ploughed deeply as early in autumn as possible, and when the proper time for potato-planting arrives, the ground is grubbed or cross-ploughed, harrowed, and made into drills; the manure is applied, and the crop planted and treated as already described. The main crop of potatoes is sown in March, and 100 stones of tubers, cut into sets, will plant a statute acre. For early use, a few drills of kemps should be planted in February. For general use, the following sorts may be recommended for field culture: White Varieties—*White Rocks*, *Scotch Downs*, and *Regents*. Red Varieties—*Skerry Blues* and *Red Rocks*.

85. Crops raised for their fleshy roots are called *root-crops;* the roots most commonly grown are carrots and parsnips, turnips and mangolds.

III. CARROTS AND PARSNIPS.

86. Carrots and parsnips are deep-rooted plants, and are treated alike. The parsnip is a wholesome and nutritious vegetable, and is saleable at a high price almost everywhere. A variety of carrots, called the *White Belgian*, is grown in small quantities for feeding horses in winter; it improves the "coat" and appearance of horses. One feed in the day is enough. Both carrots and parsnips require deep, rich ground, which should be dug deeply, and, if possible, manured

in autumn. The parsnip admits of being sown as early as the ground can be got ready for it in spring; the carrot is sown in the end of March or beginning of April. The drills for either crop may be made eighteen inches in width; when the ordinary drilling plough is used, they must be made two feet wide at least.

IV. TURNIPS AND MANGOLD WURTZEL.

87. Of all root-crops, the turnip is the most generally grown. There are three kinds of it—swedes, Aberdeen or yellow turnips, and white turnips. Swedes are the hardiest and most nutritious; white turnips are the softest and least nutritious; and yellow turnips are intermediate in quality between swedes and white turnips. Mangold wurtzel is a newer crop than the turnip. The more it is grown in dry and warm districts, the more it is valued. For the production of milk it is better than any sort of turnips; for fattening purposes it is considered slightly inferior to swedes, but superior to yellow turnips. Mangolds are less liable to casualties than turnips; and when the ground is rich, and the climate favourable, mangolds give a heavier crop. The crop requires a drier climate than turnips; and as it is more easily injured by frost, it requires to be stored earlier. It thrives best in the east and south of England. The climate of the north and north-west of England, of many parts of Scotland, and of the west of Ireland, is not so well suited to it. On reclaimed bog and moor it yields a heavier crop than turnips of any kind. The preparation of the ground is, in the main, the same for turnips and mangolds. Both crops usually follow grain, and the stubble should be dug or ploughed deeply in autumn, as soon as the corn is removed. In spring it is forked by the cottier, cleared of weeds, and made into drills twenty-six inches wide.

When one or more horses are kept, the ground is grubbed, harrowed, and rolled, until it is reduced to a fine state; it is then cleaned and made into drills. If farm-yard manure is used, it is evenly spread in the bottom of the drills, all lumps being broken; it is then covered in by splitting the drills. The seed is sown by hand on small farms, and by a machine on large farms. There is a slight difference in the mode of sowing turnips and mangolds. When a machine is not available, the turnip is sown in the following way:—A rut is made on the top of the drill with a pointed stick or corner of a hoe; the seed is deposited in a continuous stream in the rut thus made; it is covered with a rake, and in dry weather, or on dry ground, the tops of the drills are gently beaten with the back of a spade or shovel, to keep the moisture about the seed. In sowing mangolds, openings may be made at intervals of ten or twelve inches with the corner of a hoe; in each of these holes four or five capsules of seed are deposited, and a little of the finest mould in the bottom or sides of the drills is taken with a shovel, and put over the seed, and the whole gently beaten as before.

88. Mangolds are sown in the end of April or beginning of May; swede turnips as soon after as possible, or say from the 10th to the 20th May; yellow turnips from 1st to 20th June; and white turnips any time in June. The quantity of seed required per acre is—of mangolds, 6 lb.; of swedes, 5 lb.; of yellow and white turnips, 6 lb.; and of carrots and parsnips, 6 lb. to 8 lb.

89. On land capable of giving a good crop, mangolds require 25 tons, and swedes 20 tons of farm-yard manure per statute acre. If there is any difference in the quality of the manure, the best of it should be used for mangolds.

90. When from any cause a farmer has to raise roots with the aid of artificial manure, the following

may be used :—On light land, superphosphate answers very well for turnips; it is applied at a rate varying from 6 cwt. per statute acre on the better sorts of light ground, to 3 cwt. on poor, brashy soils. On medium land, the same money's worth of a mixture of four parts of superphosphate and one part of sulphate of ammonia or nitrate of soda gives a satisfactory return; and for good rich land the manure may contain a little more ammoniacal or nitrogenized matter. The ammoniacal or nitrogenized matter may be added to superphosphate by sulphate of ammonia, nitrate of soda, or other substances, taking care, as already suggested, to select one in which it can be purchased on the best terms. The nitrogen of many manures in the market is added to them in shoddy, hair, and other bodies, in which it is not so useful or so soon available. A manure composed of two parts of superphosphate and one part of sulphate of ammonia or nitrate of soda answers for mangolds on good land. This mixture, when used without farm-yard manure, may be applied at the rate of 5 cwt. per statute acre.

91. In many cases it happens that the farmer has only as much farm-yard manure as would give an ordinary dressing to one-half or two-thirds of the area of roots he wants to grow. In this case, experience tells us the surest way of obtaining a good crop of roots, and of keeping up the condition of the soil, is to distribute the farm-yard manure over the whole of the ground, using a little more for the mangolds, and supplementing it all round with the mixtures of artificial manures recommended above. If we apply two-thirds of a full quantity of farm-yard manure—for example, to mangolds—we should use one-third the quantity of artificial manure recommended to be used when no farm-yard manure is applied; and if we apply half a full dressing of farm-yard manure for

swedes, we should supplement it with half a full dressing of artificial manure; and so on.

92. In using farm-yard manure and artificial manure in conjunction, the following is found to be a good mode of applying them by hand:—The farm-yard manure being evenly spread in the bottom of the drills, every second drill is split, and at the back of the clay thus thrown over the artificial mixture is deposited by hand; the remaining drills are then split, and the seed sown, as already pointed out. In this way the plants will find artificial manure within their reach just as they are brairding, which is the most critical period in their growth; and the farm-yard manure will be available when the roots begin to swell. On large holdings the artificial manure may be scattered broadcast, or distributed with a machine.

93. Young turnips suffer very much from a pest known as the turnip-fly, which often destroys whole fields. The best safeguards against the ravages of this enemy are to sow plenty of seed, to use artificial manure to force on the young plants, and, when practicable, to use liquid manure for the same purpose. A mixture of salt, soot, and lime spread on the drills, is also found to check the fly; and when salt and soot cannot be had, lime may be used alone. Mangolds and turnips require to be thinned when the leaves have grown to the length of about two or three inches. It is usual to thin mangolds twice, leaving two plants in each clump at the first thinning, and removing the smaller of the two when it begins to interfere with the other. Turnips are thinned at once, the best plants being retained. The distance from plant to plant, in both crops, varies from ten inches in light ground, to twelve inches, or a little more, in rich land.

94. In a very dry season a good deal of the seed of mangolds and turnips does not grow at all for want of moisture. The blanks are filled up in several ways.

First, as both mangolds and swedes bear transplanting very well, a number of plants taken out in thinning them are carefully put in with a dibble or spade. This should be done when the ground is moist; the greatest care should be taken that the roots are not doubled; and the clay should be so pressed about the roots that on taking one of the leaves between the fingers the plants will not come away. It is also useful to put the plants, for half a day or a day, in clay puddled with weak liquid manure.

95. Blanks in mangolds or swedes may also be filled up with cabbage-plants, or with late turnips. We generally sow, for this purpose, a mixture of *Dale's Hybrid* and *Greystone* turnips.

96. The after-cultivation of roots consists in hoeing two or three times, to admit air into the soil, and to keep down weeds; and in digging or grubbing the spaces between the rows, to enable the roots of the plants to go in search of food.

97. The following are a few good varieties of root crops: Swede turnips—*Skirving's Purple Top; Sutton's Champion.* Aberdeens—*Dale's Hybrid.* White turnips—*Greystone.* Mangold wurzel—*Long Red* for strong ground and for reclaimed moorland; *Yellow Globe* for light and medium land. *Oval Yellow* is a good intermediate sort. Carrots—*White Belgian* for feeding horses. Parsnips—*Jersey Hollow Crowned.*

IV. CABBAGE AND RAPE.

98. *Green Crops* embrace cabbage and rape, the leaves of which are used in a green state. Both are useful for feeding stock. Neither will keep like root-crops; but as they admit—more especially the cabbage—of being sown at different times of the year, it is possible to have them coming in for use in succession. For instance, by making three sowings of cabbage-seed, in a well-prepared seed-bed, and by

putting out the plants in regular succession, we can have a supply throughout the year. One of these sowings is made in August. The crop is transplanted in April, and fit for use in autumn, at a time when grass is scarce, and before any of the root-crop is ready.

99. The cabbage grows best in a rich, deep soil. It is grown after several crops. The main crop of spring-planted cabbage is generally put into the same place in the rotation as potatoes and roots ; the plants may be dibbled on the top of drills, made and prepared in the same way as if for these crops. On spade-labour farms the manure may be forked in, and the cabbage planted, with a dibble, in lines.

100. *Drumhead* is the best variety to grow in this way on the farm; the rows of plants should be two feet six inches apart, and the distance from plant to plant in the lines, eighteen inches. On good land the yield is at least twenty tons per acre. The after-cultivation of cabbage consists in loosening the earth in the spaces between the drills, keeping down weeds, and putting earth up about the stems of the plants.

101. Another sowing of cabbage-seed is made in April ; the plants are put out in summer, and are fit for use in winter. Plants of this sowing are used for filling up blanks in mangolds and swedes. The third sowing of seed is made in the third week of July ; the plants put out in autumn for use in spring.

102. Sheep-breeders find the cabbage invaluable food for ewes suckling their lambs in spring. It is found useful to cut up the cabbage with a chaff-cutter, or some other instrument, more especially when feeding is scarce, as the chopped leaves may be mixed with other substances. In the hand-feeding of cows on small farms, we have found this practice very profitable.

103. It is useless to attempt to grow drumhead cabbage without an application of a ton of good farm-yard manure for every ton of cabbage expected. A

variety called *Thousand-headed Cabbage* gives a heavy crop of leaves, and does not require such rich ground as drumhead. The seed is sown in April; the plants put out in June and July; and they become fit for use in winter.

104. Rape is raised in this country principally as a stolen crop between grain and turnips. The stubble is dug or ploughed, and the seed sown broadcast at the rate of from 10 lb. per acre on good ground, to 14 lb. on poor land. The seed may also be sown in ruts or drills, sixteen inches asunder. The strong roots of rape loosen up clay-land; and the crop grows luxuriantly on bog-land. It is necessary to apply some manure to this crop. Ten tons of farm-yard manure, or three cwt. of superphosphate of lime, may be used.

105. Rape being, like cabbage, a slow-grower while young, the seed is often sown in a seed-bed, and the crop afterwards transplanted. For spring use the seed should be sown in July, and the plants dibbled in October in ground properly prepared for them. Sometimes the plants are carefully laid in every second furrow as the ground is being ploughed, a little manure being applied about the roots at the same time. Rape, treated in any of the foregoing ways, yields at the rate of eight or ten tons of feeding per acre; and on good land twenty tons have been obtained.

V. GRAIN CROPS.

Wheat.

106. The grain-crops raised in this country are wheat, barley, oats, and rye. Since the introduction of free trade, the growth of wheat has declined, as it can be produced cheaper in warmer climates. Good crops, especially of wheat, may, however, be profitably raised after potatoes in some of the southern, eastern, and midland counties of England, in the Lothians, and in the warmer part of Ireland. The crop admits of being

sown either in autumn or spring. Spring wheat is so uncertain that it is attempted only in exceptional seasons. In several places the growth of wheat is now very much confined to potato-ground, which is cleared in time to admit of the wheat-sowing at the best period, which is the end of October or beginning of November. On clean, level ground the seed is often sown broadcast, and ploughed in. A favourite mode of sowing wheat after a manured crop, is by ribbing—that is, the ground is made into ridglets or ribs, with a common plough stripped of its mould-board, or with a ribbing machine. The seed is scattered broadcast on the ribbed surface, and covered with a harrow. In the warmer counties of England wheat follows clover in the ordinary course of cropping. In this case the ground should be carefully ploughed, a skim coulter being used to aid in burying the grass. The seed may be sown broadcast on the ploughed surface, and crossed by the harrow. But the crop is more generally sown with a corn-drill. The quantity of seed varies from six to twelve stones per acre, according to the mode of sowing and the quality of the ground.

107. On rich, dry land, white is better than red wheat; on inferior soils, red wheat is more certain. A better climate is required for white than for red wheat. *Red Chaff White* is a favourite white variety. *White Irish* is hardy and productive. Of red varieties, *Spalding's Prolific* and *White Chaffed Red* are very good.

Barley.

108. Of late years the demand for barley has become so brisk, that it is a very profitable grain-crop on land in suitable condition. It requires the surface-soil to be rich; hence it is grown after root-crops. The preparation of the ground consists in ploughing or grubbing across the direction of the drills; in harrowing, and, when necessary, rolling, to produce a proper

seed-bed; in sowing the seed, and covering it with the harrow. The quantity of seed sown per statute acre is about ten stones. The variety of barley known as *Chevalier* is one of the best in use. Barley is sown in the end of March or beginning of April. The seed is sown in several ways, such as by ribbing, ploughing in, or drilling.

Oats.

109. Of all cereals, the oat-crop is most generally suited to the climate of the North and West of England, as well as to Ireland and Scotland. In the latter countries it is almost the only grain-crop raised on lea. It is also very extensively grown after roots, but on most well-managed farms barley pays after two crops better when the climate is not too wet. On lea ground, well ploughed, the seed is scattered broadcast on the surface; it falls into the hollows between the slices, and is covered by breaking down with a harrow the crests. When the land is badly ploughed, this mode of sowing does not answer, as a large quantity of the grain is apt to fall so low into holes and fissures, that it does not germinate. To prevent this, the seed should be sown by a drilling machine when available, or covered with the plough. Some farmers sow the seed broadcast, and cover it in with the harrow; but it cannot be evenly covered in this way. In shallow ground it often becomes necessary to shovel some earth from the furrows over the ridges, so as to secure the necessary covering for the seed.

110. Speaking generally, our small farmers do not plough their lands to more than half the proper depth for oats. The result is, that the crop is very short, and in dry seasons it partially fails.

111. The quantity of seed required per statute acre varies from ten stones in good, to fourteen stones in poor ground. The crop is usually sown about the

middle of March. Of good varieties we would name the following :—

White Oats—*Potato* for good rich ground; *Sandy* for medium land. Black Oats—*Common Black Oats* for poor cold land; *Black Tartary* for rich, moory ground, or land which contains a large proportion of vegetable matter. This variety has become a general favourite. A variety called *Tawney Oats* is sown in October, and ripens sooner than any other kind. The common black oats of the country when well selected yields well. Common speckled oats is very hardy.

Rye.

112. Rye is the hardiest of all our grain-crops. It grows in soils too poor, or in situations too exposed or elevated for oats. In Belgium it is grown more extensively than oats or barley, notwithstanding that the summer is drier and warmer than ours; but there, the rye is harvested so early that it admits of being succeeded by a crop of turnips the same year. This crop may be sown in autumn, in winter, or in spring; the best time is in the end of October or beginning of November. The quantity of seed used per acre depends on the time of sowing—twelve to fourteen stones being the average. *Common Rye* is hardy, but a variety called *Giant English* is the best. The seed is sown and covered in the same way as oats.

113. We have known poor mountain land, let at 6*s*., to produce 76 stones of rye per statute acre.

114. The yield of the corn-crops is increased, and their quality improved, by a change of seed. On this subject we shall make a remark or two further on.

VI. BEANS AND PEAS.

115. Beans and peas being raised for their seed, are sometimes classed as grain-crops; but, as the seed is

inclosed in legumes or pods, they are, with more correctness, called leguminous crops.

116. Both these crops are rich in what is called flesh-forming material—that is, they contain in large quantity the substance of flesh or muscle. Hence, they are found useful in feeding horses, which carry heavy loads in cities and large towns. They are also consumed by man; but as they contain little fatty and starchy matter, they have a costive effect, and must be used in moderate quantity.

117. The bean is best suited for strong clay-land. It is grown in several ways. Sometimes, as in East Lothian, it is raised in drills like potatoes. In some places it is often sown broadcast. In this case the ground being ploughed, and harrowed when necessary, the seed is scattered by hand, at the rate of four bushels, or more, per statute acre, and covered in the same way as corn. Very heavy crops have been obtained in this way on our heavy clay-lands.

118. An expeditious way of sowing beans is to drop the seed in every second furrow as the land is being ploughed. The plants grow in rows, the space between which can be dug or grubbed and hoed.

119. The spring varieties of beans are sown from the 1st February to the middle of March. The variety known as Russian, or winter bean, is sown in October.

120. The crop should be cut when the pods, as well as the upper part of the stem, become brown, and when the seed is easily detached from the pod. It is allowed to remain one day in the swath, after which it is bound into small sheaves, stooked, and, in due time, carried to the stack-yard. In suitable land the yield of beans is fully as much as of wheat.

121. The *pea*, like the bean, belongs to the order of leguminous plants. It is divided into two classes, namely, common garden pea, the seed of which is white; and field or grey pea, the seed of which is of a greyish colour. The pea is regarded as a

precarious field-crop. its growth is limited. and calcareous soils. The range of soils suited to It pays best on light, brashy, It is sown in the beginning of March.

VII. FORAGE AND HERBAGE CROPS.

122. We now come to consider forage and herbage plants which have been divided into artificial and natural grasses. According to this division, artificial grasses include vetches, clover, lucerne, and sanfoin, which are not grasses at all, but are given to cattle chiefly in the green state; and the rye-grasses, which are true grasses. All these plants are called artificial grasses, because they are cut and given to cattle by hand.

The Vetch.

123. The tare or vetch is, in this country, chiefly grown as a stolen crop after corn. The ground—being clean—is dug or ploughed, farm-yard manure at the rate of ten to twelve tons per acre is applied, the seed sown broadcast, the ground harrowed to cover the seed, and some earth shovelled from the furrows to complete the covering. A sowing of it should be made as soon after harvest as the ground can be got ready; and a second sowing a fortnight later. As the stems of the vetch do not stand erect, it is necessary to sow along with it rye, oats, or Italian rye-grass. Rye may be mixed with the seed of the first sowing, and a mixture of rye-grass and oats with the second, and oats only with the third. This crop yields on an average twelve tons of forage per acre, and affords excellent feeding for all farm animals; and on small farms it has the advantage of coming into use at a time when other feeding is scarce. The quantity of seed is about two bushels per statute acre, with a bushel of rye, oats, or rye-grass.

124. As vetch-seed is very dear, farmers ought to

allow a small portion of the crop to come to maturity, so as to raise their own seed.

125. The small farmer who house-feeds in summer may sow in autumn at least twenty perches of this crop for every milch cow kept on the farm.

126. Vetches sown in spring afford excellent feeding in summer and autumn. Cottiers and small farmers who house-feed their cows in summer ought to use the crop for this purpose. Several sowings of it may be made from February till May, so that the produce of these several sowings may become ready for use in succession.

Lucerne.

127. Lucerne, though a very useful forage-crop, is little known in many parts of the country. It grows best in rich land, but is most valuable on medium land. It may be planted in waste corners and places which could not be easily tilled. It is sown along with a corn-crop in the same way as clover and grass-seed; it is also sown by itself. If sown alone, the ground should be deeply tilled, and made quite even, the surface made into ridglets or ribs, the seed sown, and covered with the rake or harrow. The ruts are made at least fifteen inches apart. The best time for sowing is the middle of April. Twelve pounds of seed per statute acre is enough. If sown broadcast, three or four pounds additional may be used.

128. One good cutting is sure to be obtained the first year; and on good land two may be produced. In the year after, the crop will be in full bearing, and give three cuttings; and if the spaces between the rows of plants be hoed after the last cutting in autumn, and a top-dressing of farm-yard manure or of good compost be applied, at the rate of ten tons per acre, it continues to yield a good return for eight or ten years.

129. Lucerne is one of the first forage-crops avail-

able in spring. It is, therefore, of great value to the small farmer who house-feeds, and who often has a difficulty in providing feeding for his animals before the clover or rye-grass is fit for use. The second crop of lucerne becomes fit for use at another critical time —namely, between the first and second cutting of clover or rye-grass.

Sanfoin.

130. Sanfoin is somewhat like lucerne in its habits of growth. It may be sown with a corn-crop; or by itself in the beginning of April, at the rate of two or three bushels of seed per acre. It gives one cutting the first year, and is not fully grown till the second or third year.

131. This plant is deep-rooted, and is capable of growing in light, calcareous, and stony ground, where rye-grass, clover, or even lucerne, would not pay. Every tillage farmer who holds land of this class should have a plantation of it for the feeding of his cows in summer.

132. Both lucerne and sanfoin may be made into hay. After eight or ten years these crops die out. The land should be then put under other crops for four or five years, after which either may be sown again in the same ground.

VIII. CLOVERS.

133. There are several kinds of *clover*, the most common being called, after the colour of the blossoms, red, yellow, and white. Red clover is far the most productive. Being a deep-rooted plant, it is extensively grown in the east and south-east of England, where, owing to the dry climate, there is not moisture enough in the surface-soil to nourish rye-grasses, which are surface-rooted plants. Red clover grows luxuriantly in these countries; but if repeated

oftener than once in eight years, the land becomes, as already stated, what is called clover-sick, and refuses to grow this plant. The mode of preventing clover-sickness has been already explained. Red clover is sometimes sown alone, but is generally mixed with other seeds, such as rye-grasses. If sown alone, sixteen pounds of seed should be used; and as the seed is very small, the surface of the ground should be reduced to a very fine state before sowing. Red clover gives two and sometimes three heavy cuttings in the year, after which it begins to die out. Yellow clover is raised as a forage-crop on poor light land, which would not yield red clover. It is not, however, a productive crop. White clover is not sown except in small quantity in mixture for permanent pasture. It affords sweet herbage, and is greatly relished by sheep.

IX. THE GRASSES.

134. Of true grasses, the best for forage purposes are named rye-grasses, and are so called because of a slight resemblance they bear to common rye. There are two species of rye-grass in use; namely, Italian rye-grass and perennial rye-grass. They are very like in appearance, and are grown and used in the same way. Of the two, Italian rye-grass is the more productive. On deep, cool soils, it is, in many places, the best forage-crop we possess. It is most productive in wet climates. The heaviest crops of it are obtained on reclaimed bog in the west of Ireland. It gives two, three, and sometimes four cuttings in the year, in favourable situations. It is generally sown with a corn-crop at the rate of about three bushels of seed per statute acre.

135. It has been sown alone in autumn, after potatoes, at the rate of four or five bushels. In this case, it is necessary to sow it not later than September, so that the plants would be sufficiently strong to bear the

winter's frost. Enormous crops of it are obtained in this way.

136. The seed of Italian rye, and indeed all seeds, are grossly adulterated. Farmers would, therefore, do well to save as much of the seed of this crop as would supply their own wants. The second cutting in the season, which is free from weeds, should be used for this purpose.

137. Perennial rye-grass is often mixed with the Italian, in the ratio of two-thirds Italian to one-third perennial. The Italian grows in tufts, and the perennial helps to fill up the spaces between these tufts. On rich soils, Italian grows so rapidly, and the stems and leaves cover the ground so soon, that it is unnecessary to mix anything with it; but in other places it is better to use the mixture.

138. On all soils, except those which are very rich, Italian rye-grass begins to die out after the first year. Perennial rye-grass is more lasting; hence its name. It is not, however, a true perennial plant; in fact, it rarely lasts more than a year longer than Italian.

139. There are a great many species of permanent grasses; but not more than ten of them, which we shall now name, should be sown by the farmer.

140. *Cocksfoot* is a productive grass, and is so called from the resemblance of its flower-stalk to a cock's foot. It grows in all soils except those which are saturated with water, or too light in texture. It is met with in all good meadow-land, and is readily known by its strong leaves, which are numerous, of a deep-green colour, and grow with great rapidity. It should enter into all mixtures for meadow-land. It thrives particularly well in shaded places; and when mixed with the weaker sorts in such situations, it becomes a support to them, and prevents their foliage from being rotted on the ground.

141. *Timothy*, or *Meadow Catstail*, is best adapted

for deep, moist soils, and is said to excel all other grasses on strong, tenacious clays. It also grows well on reclaimed moory ground. It should, therefore, form part of all mixtures on such lands for meadow or pasture. The aftergrass of Timothy is very light, which has brought it into disfavour.

142. *Meadow Foxtail* is the earliest of the valuable grasses, and forms a large proportion of the herbage in our best pastures. It throws out from the crown of its root long, broad, and succulent leaves, which are renewed with great rapidity — a circumstance which greatly enhances its value for permanent pasture. It answers very well for irrigation. As it does not reach its full size for three years, and throws up a comparatively bare stem, it is not sown in mixtures for one or two years' grass.

143. *Rough-stalked Meadow Grass* is very generally met with in good meadows and pastures. It grows most luxuriantly in rich moist soils, and does very well in the shade of trees and in irrigated land, but gets burned up in the heat of summer on light, dry ground. It throws out shoots from the root at the base of the culms, which trail on the ground, and send down small roots at their joints in moist weather. Its habits of growth fit it admirably for being sown along with the more upright kinds of grasses, such as rye-grass and meadow fescue.

144. *Smooth-stalked Meadow Grass* is not so valuable as the last-named plant, which it resembles in some respects. As the names of both indicate, the stem of the one is rougher than that of the other. The root of the rough-stalked meadow-grass is fibrous, or but slightly creeping, whereas the smooth-stalked species has a creeping root. The smooth-stalked meadow-grass, too, is the smaller plant. As a rule, grasses with creeping roots thrive better in light land than grasses with fibrous roots. This grass cannot be recommended for cultivation, except, perhaps, to enter

in small quantity into mixtures for soils which are too light for more valuable grasses.

145. *Meadow Fescue* grows abundantly on rich pasture, especially where the soil is somewhat moist; but it is not well suited for light, dry land. The stalks are strong and coarse; but they are greedily eaten by horses and cattle.

146. *Hard Fescue* is, perhaps, more abundant in British pastures than any other grass. It thrives in a great variety of soils, but it is best suited for dry, light land, and forms a very large proportion of our sheep-walks. It resists the drought of summer, retains its verdure during winter, and is more productive than its dwarfish habits of growth would indicate. It is a good grass to sow with others in lawns, when it is desired to produce both a pleasing effect and a good return.

147. *Sheep's Fescue* forms a large proportion of the herbage of sheep-pastures, especially those in elevated situations. It is a smaller grass, and less productive than either meadow fescue or hard fescue, but it is greatly relished by sheep.

148. *Crested Dogstail* is a grass on the merits of which there is a great diversity of opinion. Like meadow foxtail, it throws up a number of root-leaves, of which sheep are very fond. Unless pasture which contains much of this grass is kept closely stocked, it throws up hard wiry stems, which sometimes irritate the eyes of sheep, and which neither sheep nor cattle eat until winter. It should, therefore, be used sparingly in putting land into grass. It has deep roots which enable it to resist drought.

149. *Sweet-scented Vernal Grass*, which is supposed to give out the agreeable odour so characteristic of newly-made hay, is not a productive grass; but it begins to grow early in spring, and continues growing up to a late period in autumn. It should be introduced only to a limited extent into any mixture of grass seeds.

150. *Fiorin Grass* has a creeping root, each stolon or joint of which is capable of sending independent roots into the ground and producing an independent plant. It gives a weighty crop on salt marshes and reclaimed bog, where other grasses would not thrive. It is also a useful grass on irrigated lands, especially those of a moory or peaty character. Fiorin grass is propagated either from seed, or by chopping up the plant and planting the stolons in rows.

151. The foregoing list includes the most valuable grasses. There are two others very common in this country which we shall notice, in the hope that they will be avoided by farmers. Soft meadow grass, called also "*Yorkshire Fog*" and "*White Hay*," is too prevalent. It is covered with soft, downy hairs, and it is found that all grasses of this kind possess little value. This grass is little better than a weed, yet it often forms a large part of the mixtures sold under the name of white seeds.

152. Brown grass seeds are obtained from the hay of old meadow land. Large quantities of these seeds are sold in many places for laying land down to permanent pasture. If the hay contained the proper grasses in the proper proportions, farmers would, to some extent, be justified in buying these seeds; but as a great deal of the hay sent to market is not made up of the proper grasses, it is not safe to rely on these brown seeds.

153. The farmer should take every possible precaution to procure genuine grass-seeds. He is too much in the habit of buying at a cheap rate what are called white hay-seeds, and which are the sweepings of lofts in which hay made from artificial grasses are kept. These seeds often contain a large quantity of the seed of Yorkshire fog referred to above, as well as the seeds of weeds, whose eradication afterwards costs a great deal of labour.

154. *Creeping Soft Grass* is another plant of the

same class, often met with in meadow and pasture land, but not to the same extent as Yorkshire Fog. It is not only downy and innutritious, but it has a creeping root, which gives it the character of a troublesome weed.

155. A rich, clean soil is required to produce good crops of the grasses ; and as their seeds are small and delicate, they also require the seed-bed to be extremely well pulverized. We have seen that the place in the rotation usually assigned to them is after the grain that follows manured roots and potatoes.

156. Barley is regarded as the best corn-crop with which to sow grasses ; oats is next ; and wheat the least suitable of the three. This partiality for barley arises from several circumstances. The surface soil is reduced to a very fine state for barley, and grass seeds, which are small, require very fine earth. Wheat is generally sown in stiff clay land, which cannot be well prepared for seeds, especially when sown in autumn or winter. On most soils, well managed, grass seeds do remarkably well after wheat.

157. The mode of sowing grass-seed with spring corn is as follows :—The grain being covered with the harrow to a sufficient depth, the ground is rolled to break all lumps and produce a fine seed-bed, the grass-seeds are then evenly distributed, and harrowed in with a bush-harrow, or seed-harrow (which is much lighter, and has shorter tines than a common harrow), and the ground again rolled. It has been ascertained by careful experiments that grass-seeds should not be covered to a greater depth than half an inch. When covered too deeply many of them do not vegetate at all. In order to distribute the seed evenly it is a good plan to sow one half of them up and down and the other half across. In laying down grass-seeds with winter-sown wheat the ground is first harrowed and rolled, if necessary. The seeds are then sown, harrowed with a light or seed harrow, and the ground rolled.

158. In laying land of good average quality down to permanent pasture, the following mixture may be sown with a corn-crop :

	lb.		lb.
Italian rye-grass . . .	5	Meadow fescue . . .	2
Perennial	6	Hard fescue	4
Cocksfoot	7	Red clover	3
Timothy	5	Yellow clover	1
Rough-stalked meadow grass	2	White clover	3
Meadow Foxtail . .	2	Alsike clover	1

For sheep-walks, and more especially in elevated situations, Italian rye-grass and cocksfoot are left out, the quantity of perennial rye-grass is diminished and the quantity of hard fescue increased.

HAYMAKING.

159. We find that the grasses, while the blades are young, contain more water than at any subsequent period; that as they grow in size, sugar, fat, and flesh-forming matters are produced ; and that, until the seed begins to grow, they not only continue to increase in bulk, but the quality of a given weight of that bulk improves. If permitted to grow beyond this stage, the feeding quality of the plants is greatly deteriorated, woody fibre being rapidly produced at the expense of the sugar. We may safely assume that, so far as the quantity of the produce (including the aftergrass) is concerned, we obtain the maximum by mowing the grasses when in blossom. As, however, all grasses do not flower at the same time, the following rules may be observed :—

160. Italian rye-grass should always be mown on the appearance of the flowers. Ordinary rye-grass may be allowed to produce the flowers. Clover is best cut when the heads are in full blossom. Mixed meadows should be mown when the bulk of the herbage is in full flower, or when the seeds of the earliest

grasses are fully formed, such as sweet-scented vernal grass and meadow foxtail; and the seed of the late grasses, such as crested dogstail and meadow fescue, are just beginning to produce the floral organs. Timothy, Italian rye-grass, perennial rye-grass, and cocksfoot generally flower during the latter half of June, which is the proper time for mowing the cultivated grasses.

161. The ruling idea in the saving of hay should be to allow it to remain in the field as short a time as is absolutely necessary, and to rick it as soon as it can be done with safety. The time within which this can be accomplished varies with the succulence of the grass and with the weather. In the case of rye-grass, and mixed grasses, from light or dry soils, the period may, by skilful management, be reduced to four days in dry weather; in rich low-land it takes at least a week or ten days. By delaying the process too long, the hay is burnt up by the sun; and it is also liable to have its soluble constituents washed out of it by rain. Well-made hay retains its green colour, and possesses an agreeable odour. Hay exposed to too much sun and rain is of a whitish colour, without flavour, and looks dry and coarse like straw. To promote uniformity in the colour of the hay, all parts of it should be equally exposed to the sun and air. In half-a-day or a day after it is mown—the exact time depending on the character of the grass and the state of the weather—the swath is turned over and shaken. This work is done by the hand or fork on small farms, and by a machine called a hay-tedder on large farms. When both sides become sufficiently exposed to sun and air, the grass is made with forks into cocks, called fork-cocks. Next day these cocks may be opened, and the hay made into larger cocks in the evening. In a day or two after, these cocks may, if necessary, be made into still larger ones, from which the hay may be taken to the stack-yard. Should wet overtake the farmer in making hay, the safest plan is not to meddle with it; for each

time that we turn or disturb it, a fresh surface is exposed to the solvent and deteriorating action of the rain. It will keep quite safely for several days in well-made cocks of 5 cwt. each.

162. Some farmers who have a very considerable area under meadow do not rake the hay into cocks as described, and are contented with raking it into wind rows in the morning, and opening them out next day, or when necessary, and remaking them in the evening. This system saves labour; but it cannot be practised with safety in humid districts.

163. The hay crop suffers deterioration chiefly from the following causes:—first, rain; second, loss of fragrance by fermentation; third, loss of colouring matter; fourth, it is allowed to remain in the field until a portion of it is rotted away; and this again involves loss of aftergrass.

164. Hay contains a considerable quantity of matter soluble in water, varying from 6 to $8\frac{1}{2}$ per cent., which is liable to be washed away by rain. Considering the rainfall in Ireland, we shall not be considered to overstate the case when we assume that, during the process of haymaking, the Irish farmer permits the rain to run away with 5 per cent. of the valuable constituents of the crop.

165. The loss of fragrance deteriorates its value to an extent which has never been estimated, and which it is not easy to determine. The peculiar fragrance of hay is produced by a volatile organic compound, which is probably the body that imparts any extra value they possess to those cattle-foods which are puffed off at such exorbitant prices. In excess it produces an injurious effect upon the brain of all animals; but in moderate quantity it incites a healthy action in the glands that secrete the saliva, without a due quantity of which all nutrient constituents of the food (hay included) cannot be digested and assimilated.

166. When hay ferments, the alcohol, in the presence of water (rain), dissolves this compound, and

thus destroys the fragrance of the hay, and deteriorates its value. And though we cannot determine with any degree of accuracy the injury done to the hay, yet in practice we find a difference of 50 per cent. in value between well-saved and very badly-saved hay from the same ground.[1]

167. The natural green colour of the grasses should, as far as practicable, be preserved in converting them into hay. The colouring matter is a vegetable fatty or waxy body, which, like that which gives fragrance, is separated by alcohol. When the grasses dry in the open air, this substance becomes oxidized, and the more oxygen it takes in, the more the colour changes. It is evident, therefore, that the sooner hay is ricked the better; for the longer we expose it to the air, the more it becomes oxidized and diminished in value. If ricked too soon, however, the loss of fragrance by fermentation (without speaking at all of the loss of sugar, &c., from the same cause) would more than counterbalance the advantages of retaining the green colour.

168. That a considerable quantity of hay is lost annually by being allowed to remain too long in field-cocks is well known to anybody who has travelled much through the country. The portion on the ground, as well as that on the outside of the cocks, is too often only fit for manure. And the aftergrass, as well as the subsequent year's crop (if hay or pasture), suffers to the extent of from *6d.* to *1s.* per acre. If we unite all the foregoing sources, the loss annually sustained in these countries is enormous.

ON FLAX.

169. The flax plant affords profitable employment to a large number of persons, and supplies the raw material for the linen industry of the country.

[1] "A difference of an hour in a very hot, drying day is supposed to occasion a loss of 15 to 20 per cent. in the hay, by its being carried beyond the point of perfection."—YOUNG, *Farmer's Calender.*

170. Flax suits a variety of soils. It succeeds best in cool land of medium strength.

171. In order to produce flax of fine fibre, the land should not be too rich. On the other hand, it is useless to grow it on very poor land. There is a great want of skill in the management of the flax-crop in this country. It is grown too often on the same land. In Belgium and the north of France, where first-class fibre is produced, it is not repeated on the soil until after the lapse of ten or twelve years; and for the production of fibre for cambric the interval often extends to eighteen years.

172. On ordinary land, the best place for flax is after lea-oats. If the farmer pursues the five-course rotation on the tillage portion of his land, he can modify it as follows, and repeat the flax on the same ground once in twelve years, thus :—

1st—Root-crops.
2nd—Grain, with seeds.
3rd—Grass—1st year.
4th—Grass—2nd year.
5th—Lea oats.
6th—One-half the field is put under flax.

The remaining half is cropped with grain, potatoes, rape, or vetches, according to circumstances. Six years afterwards the flax can be put in this section of the field. In many parts of Ulster flax occupied the whole of the ground every sixth year, and in some cases it was repeated at shorter intervals. The result has been injurious.

173. The ground, in preparation for flax, should be deeply tilled in autumn; and in spring the surface should be reduced to the finest possible state of tilth. It should also be made as even as possible, to ensure plants of uniform length; and all root-weeds should be carefully removed.

174. The seed is sown as early in April as the ground can be got ready for it, the quantity of seed

used being $2\frac{1}{2}$ or 3 bushels per statute acre. To ensure an even braird, it is a good plan to sow one-half the seed by going up and down the field, and the other half by going across it; and to secure this still further, it is covered in by giving a double stroke of the harrow up and down, one straight across the field, and another in the direction of one of the diagonals.

175. Flax is fit to pull when the stems become yellow to about two-thirds their height from the ground.

176. The bolls, or capsules, which contain the seed, ought to be preserved, as they make excellent feeding for calves and milch cows. A statute acre of flax ought to produce twenty-five stones of scutched fibre, which would bring from 8*s.* to 12*s.* a stone. Riga seed is the best for moist soils; but on strong, low-lying land, Dutch seed is found to give a better return.

177. In order to obtain fibre of the best quality, the flax is pulled before the seed is fully formed. In this case, the seed is sacrificed. The usual practice in these countries is, however, to pull the crop when the seed changes to a brown colour, and when the stems become yellow to about two-thirds its height from the ground. It is usual to remove the seed in the field by an instrument called a ripple, and to steep the crop immediately after in a pool of suitable soft water. In those parts of the Continent where fibre of the highest value is produced the flax-crop is not steeped until the year after it is grown.

178. It is an interesting fact that the value of the fibre in different parts of the stem of a flax-plant varies. The middle part is the best, the part next the root is next in value, and the upper part the least valuable of all. In mills which spin first-class thread, advantage is taken of this fact, by using each of these parts separately.

PART III.

LIVE STOCK.

I. ON THE FOOD OF ANIMALS.

179. The nutrition of animals is governed by laws which every person ought to understand. We shall give an outline of these laws by explaining the various purposes served by food in the animal. The component parts of food may be grouped as follows :—

1. Water.
2. Heat-giving materials, such as starch and sugar —compounds identical in composition, and supposed to be equal for feeding.
3. Oil or fatty matter.
4. Flesh-forming material, such as the gluten of wheat.
5. Woody or indigestible fibre.
6. Ash, or mineral matter (a large portion of which is composed of phosphate of lime, the well-known substance of bones).

180. The value of any feeding substance depends mainly on the proportions in which these six groups exist in it. The food which the animal takes in through its mouth passes into the stomach (or stomachs, of which the cow and sheep have each four, and the horse and the pig only one each) ; after being acted on by various agents in this organ, the indiges-

tible or innutritious part passes away through the intestines, and the nutritious part is conveyed to the blood.

181. Overlooking water, which is a most essential part of food, the constituents we have first to consider are sugar, starch, and similar compounds. These, it has been found, go to support animal heat. Animals could not exist without heat; and the heat they require is chiefly kept up by the consumption of starch and sugar, which are, therefore, very properly called heat-givers. We know that starch and sugar are also capable of producing fat in the animal body. It is well known, for instance, that more fat is stored up in the bodies of pigs than could be produced by the fatty matter of the food. The temperature of the body of an animal is about the same in all climates, provided it is properly fed. The blood of man, *e.g.*, is as warm in the Arctic as in the Torrid regions of the earth. In the former or colder climate, he must eat more carbonaceous food, or more starch, sugar and other compounds capable of supplying carbon, to keep up animal heat.

182. The same holds good with regard to live stock. If we leave them exposed to cold they must eat more food to keep up the necessary heat of the body. This shows the necessity of providing suitable shelter for farm animals in winter.

183. The fat of animals is identical in composition with the fatty or oily matter found in plants; and it is believed that the fat of the food goes to form the fat of the body. The fatty matter of food is also capable of supplying animal heat. We are convinced of this by the fact that in several northern countries the people do not use any food containing starch, sugar or similar compounds. There is this difference, however, between the fatty and starchy matter of food as producers of animal fat, namely, that an animal can produce its own fat from the fatty matter of its food more readily than

from compounds not fatty in their nature, such as starch and sugar. A pound of fatty matter is supposed to be equal to two and a half pounds of starchy matter, or sugar, for fattening purposes. The more fatty matter, therefore, any kind of food contains, the better it is adapted for the fattening of stock. Linseed (flax seed) contains 34 per cent., or about one-third of its weight, of oil; and is, when properly used, one of the most rapid fat producers we have. Used largely it has a laxative effect. The oil is so valuable for other purposes, that the seed is pressed in mills, the oil extracted, and a solid residue or *cake* is obtained, which contains about twelve per cent. of oil, and is sold under the name of oil-cake or linseed-cake. Oil-cake from linseed, when free from adulteration, is one of the best substances which the farmer can use for fattening cattle and sheep. Rape-seed, which contains a great deal of valuable oil, is also pressed in the same way; the oil, called colzâ oil, so extensively used in lamps, is sold to oil merchants, and the cake called rape-cake, which contains about eleven per cent. of oil, is sold to the farmer for feeding stock. Compared with linseed-oil cake, rape-cake appears to be very cheap. It does not, however, agree with cattle or sheep as well as linseed-cake. Before using rape-cake it is recommended to subject it to the action of boiling water. We are of opinion that rape-cake pays best when given to store cattle and milch cows. Notwithstanding the higher price of linseed-cake it pays better than rape-cake in the fattening of cattle or sheep. Rape-cake when adulterated with the seed of wild mustard, is injurious to stock. By making a small quantity of it into a paste, the pungent smell, so characteristic of mustard, will be emitted if the cake is adulterated with mustard seed.

184. A cake, called cotton cake, is obtained from the seed of the cotton plant. Made from the whole seed, it contains six per cent. of oil, and upwards.

When first introduced the husk was not ground in any way; the result was that animals died from inflammation of the intestines, caused by the lodgment therein of this indigestible woody matter; but, as now manufactured, it is safe and good for all stock, especially milch cows. When the cake is deprived of this husk, and becomes what is known in the market as "decorticated" cotton cake, it contains 10 per cent. of oil. This variety answers very well for fattening cattle when first put up to fatten; but as they advance towards maturity no cake is equal to that which is made from linseed. There are several other kinds of cake, and of artificial feeding substances in the market, such as cocoa-nut cake and palm-nut meal. At a moderate price we have found the latter useful for the production of an increased flow of milk in farm animals.

185. The flesh-forming constituents of food supply the muscles of the body. The muscles and all the tissues of an animal are continually wearing away. Even in a state of perfect health and repose this process goes on. If we wish the animal to keep up its health and condition, the matter removed in this way must be supplied to it in the food. It has been estimated that a man's body is renewed in about half-a-dozen years. In flesh and bone, therefore, we are not to-day what we were yesterday. The degree of waste which the body of any animal suffers varies with a great many circumstances. Disease or irritation increases it very much. A sheep suffering from foot-rot does not produce as much mutton from a given quantity of food as when free from this affection. A cow of a restless disposition does not thrive as well as one of quiet temper.

186. Exercise, whether mental or bodily, accelerates the waste of the tissues. The harder a horse is worked, the more food he requires. It follows, that in fattening cattle, the quieter we keep them the greater the quantity of meat we are likely to get from a given

quantity of food, because the less of the latter is expended in supplying the waste of the body.

187. Woody fibres enter very largely into the composition of our farm crops. It is made up of the same elements as starch, sugar, and gum; but, as it is indigestible (or nearly so), its chief use is to give bulk to the food, so that it may be detained sufficiently long in the stomach to be thoroughly acted on.

188. The mineral constituents of the food are required to supply the mineral matter of the body. The bone and framework of the animal could not be formed without mineral matters; and as these matters are wasted, like the other constituents of the tissues, the food must always afford a fresh supply. If the food is deficient in phosphorus, the bone is weak, and the limbs unable to bear the animal. We have frequently seen young pigs suffering from weakness of the bone, which may be prevented, and where it already exists, sometimes even cured, by affording food rich in the substance of bone. Lime, which is a constituent of phosphate of lime, is required to build up the bone. Phosphate and carbonate of lime exist in the ashes of our pasture grasses and grain crops, the seed of the latter being particularly rich in phosphate of lime. The hard shell of the eggs of poultry is composed principally of carbonate of lime, and instinct teaches the common hen to pick up pieces of mortar, gravel, or chalk, which contain this substance. Iron is an essential constituent of the colouring matter of the blood. Common salt affords two most important constituents, which appear to be necessary for digestion. Man obtains the saline matter necessary for his body in flesh meat, milk, and the common salt which is so universally used at table. Our crops contain comparatively little common salt, and hence it is used largely by those who live principally on potatoes. The intelligent farmer also gives common salt to his live animals, knowing that it not only causes them to

thrive better, but that it also prevents many diseases which would otherwise affect them. Full-grown cattle may occasionally get a couple of ounces of it daily; horses, from one ounce to two ounces; sheep and pigs, about half-an-ounce. Grazing cattle and sheep should have access to lumps of rock-salt in the field. Lumps of it may be also placed within reach of stall-fed cattle, or it may be strewed over or mixed with their food. The best way of giving it to horses is by dissolving it in the mashed food which ought to be occasionally prepared for them. It is given to pigs mixed with their food.

189. We append a table giving the proportions of the foregoing constituents in the several crops and feeding stuffs.

Kind of Food.	Every 100 parts (by weight, say lbs.) contain as follows.					
	Water.	Flesh-forming Matter.	Starchy and other heat-giving Matter.	Fatty Matter.	Woody Fibre	Ash.
1. *Seeds.*						
Wheat	15.0	12.0	66.5	2.0	2.7	1.7
Oats	14.0	11.5	58.5	6.0	7.0	3.0
Barley	16.0	10.5	65.0	2.0	3.5	3.0
Bere (mean of 4 analyses)	14.2	10.1	62.6	2.0	9.03	2.02
Rye	16.0	9.0	(66.0)		8.0	7.0
Beans	14.8	23.3	47.0	1.5	10.0	3.4
Peas	14.1	23.4	48.3	1.7	10.0	2.5
Linseed	7.5	24.4	30.7	34.0		3.3
Tares	15.3	20.1	53.9	1.8	5.3	3.4
Indian Corn	14.5	10.0	61.0	8.0	5.0	1.5
Rice	14.0	5.3	(78.5)		2.5	0.7
2. *Fodder, Straw, Hay, &c.*						
Wheat	14.2	1.79	29.9	1.1	45.4	7.5
Oats	12.1	1.63	36.6	1.2	43.6	4.8
Barley	14.3	1.68	38.9	1.0	39.8	4.2
Rye	14.3	2.29	(37.1)		43.2	3.1

Kind of Food.	Every 100 parts (by weight, say lbs.) contain as follows.					
	Water.	Flesh-forming Matter.	Starchy and other heat-giving Matter.	Fatty Matter.	Woody Fibre.	Ash.
Meadow hay (average of 25 samples)	14.6	8.4	(43.6)		27.1	6.1
Meadow hay, very inferior, one year old	13.1	4.0		(77.6)		5.2
Bean straw	19.4	3.3	6.5	1.0	65.6	5.7
Pea do.	12.0	12.5	19.6	2.3	47.5	6.0
3. *Green Food, Roots, &c.*						
White Turnips (white Globe)	90.4	1.1	(5.45)		2.3	0.6
Purple top, Aberdeen, collected 5th October	89.9	1.06		(8.2)		0.9
Swedes	89.5	1.4	(5.9)		2.5	0.6
Mangold-wurzel	87.8	1.5	(8.6)		1.1	0.9
Carrots (white Belgian)	87.3	0.7		(11.2)		0.7
Parsnips	82.0	1.3		(15.7)		0.9
Cabbages (outer leaves	91.1	1.6		(5.06)		2.2
Cabbages (heart	94.5	0.9		(4.1)		0.6
Potatoes, White rocks (seed sample)	76.0	2.0	15.0	0.2	5.5	1.0
Vetches	82.5	3.8		(12.4)		1.3
Rape (green)	87.0	3.1	4.0	0.6	3.5	1.6
Rye (green)	75.4	2.7	9.1	0.9	10.5	1.3
Furze	72.0	3.2	8.2	1.2	13.3	2.1
4. *Artificial Food.*						
Linseed-cake	12.4	27.3	34.5	12.8	6.5	6.1
Rape-cake	10.7	29.5	30.9	11.1	10.0	7.8
Cotton-cake from whole seed	11.3	23.7	31.0	6.2	21.2	6.5
Do. with some of the husks removed, — the "decorticated" cotton-cake of commerce	9.3	41.2	16.4	16.0	8.9	8.0
Poppy-cake	6.6	34.0	23.2	11.0	11.3	13.8
Bran	12.8	13.8	50.1	5.5	11.5	6.1
Brewers' grains	75.8	0.6	1.1	?	21.2	1.2
Do. (draff)	74.7	3.6		(20.3)		1.3
Hemp-cake	7.2	21.5	22.5	7.9	25.1	15.8
Malt dust	6.2	25.6		(59.4)		8.7
Oat dust	5.6	4.8	45.7	3.6	35.3	5.0
Barley dust	11.0	8.4	69.7	3.5		7.3
Palm kernel-cake	10.7	13.4	27.4	11.4	33.0	4.0
A specimen of condimental food	11.4	11.4	64.0	4.1	6.2	2.8

190. This table is a mere approximation to truth. An accurate table cannot be prepared in the present state of science; for, in the first place, it is well known that soil and climate influence the composition of the same plant very much, and samples of crops raised on soils and in circumstances alike in every way have not been analyzed; secondly, there are defects in the present mode of determining some of the constituents of food; thirdly, such a table does not take any cognizance of the mechanical condition in which the different kinds of flesh-formers, heat-givers, &c., exist in the food. For example, flesh-forming material may exist in a more digestible state in one food than in another. And so also, in accordance with the old saying, that "what is one man's meat is another man's poison," a constituent of food may be easily digested in the stomach of one animal, while it may be digested with difficulty, or be altogether incapable of undergoing digestion, in the stomach of another.

II. THE SEVERAL BREEDS OF CATTLE.

191. The most valuable kind of cattle we possess is the short-horn, which was established in the north-east of England in the last quarter of the eighteenth century. Among the men to whom the world is indebted, for the great perfection to which this race of animals has been brought, we may mention the brothers Charles and Robert Colling of Darlington, Mr. Bates of Kirklevington, and Messrs. Booth of Wallarby and Killerby. Several other persons also aided in the work. The results of the labours of all these men afford to our farmers a most instructive lesson. For example, Mr. Charles Colling commenced his career with cattle which at the time would bring only ordinary market prices, or a shade higher. Yet in about a quarter of a century he brought his cattle to such perfection that at his sale in 1810 forty-seven

animals realized 7,115*l.* 17*s.*, or an average of 151*l.* 8*s.* a piece.

192. This result was accomplished by the exercise of skill and judgment. The improvement that may be effected in a short time is well illustrated by the following saying of Charles Colling: "Give me my sight, and the touch of my fingers, and in a half-dozen years I will produce as good a herd as I have sold off."

193. Animals of this breed have good shape and symmetry, deep and level carcase, fine limbs, and that quiet disposition which is so favourable to fattening. They have a soft mellow hide, which is covered with a soft thick coat of hair. The colour is roan red, red and white, or white. Of these roan is most in favour; red is liked by dairy farmers; and white is objected to by many.

194. The breed is, on the whole, noted more for the production of flesh and fat than milk; but this has arisen, as already explained, from the fact that the milking properties have not received sufficient attention. Farmers should, therefore, resort to herds in which the two properties are united. A little consideration will enable us to see that animals in which the two properties are blended will best pay most tenant farmers. Milk and its products, butter and cheese, which now bring such high prices, cannot be overlooked. On the other hand, we must rear store stock for the grazier and stall-feeder, and the prices got for these animals depend on their aptitude for fattening, which is known by their style, colour, and quality when handled. It is in this respect that the short-horn is unrivalled.

195. There are several other valuable breeds of British cattle, such as Hereford, Devon, Ayrshire, Polled cattle, and Kyloe.

196. The Hereford is an excellent variety for grazing purposes; but as it does not combine milking, and fattening qualities in the same degree as the short-horn, it cannot compete with the latter for general

use. One of the best known varieties of this breed is known by its colour, which may be described as red with white face, and white also on the back, and on the underside of the body.

197. The Devon is of a blood-red colour all over, has a symmetrical carcase, and was in great favour on account of its action when cattle were used for draught more than they are at present. It is not a good milking kind, and is used chiefly for grazing purposes, on its native soil and in similar places.

198. In England several new breeds have come into existence of late, such as the Norfolk, Suffolk, and Sussex cattle. The more intelligent farmers in these several counties having come to see that nature everywhere impresses certain characters on the animal frame which ought to be preserved, have blended with these characters as many as possible of other qualities which suit their purpose.

199. The Ayrshire breed is the best we possess for the production of milk; but being slow in putting on flesh it cannot rival the short-horn.

200. The Polled cattle of Scotland (of which there are several varieties, namely, Polled-Aberdeen, Polled-Angus, and Polled-Galloway) are very valuable in their own native districts; they fatten well, but are not good milkers.

201. The Kyloe or West Highland is one of the hardiest breeds of cattle in the British Islands. It has long flowing horns, and is covered with a coat of long and thick hair which protects it from the weather.

202. The Kerry is the only pure breed in Ireland. It is essentially a mountain breed. It is small in size, exceedingly hardy, and can subsist on poor and exposed pasture, and often bears a close resemblance, in size, shape, and colour, to the native cattle of Wales and Brittany. The colour preferred in Kerry is black, with a ridge of white along the spine, and a white streak along the underside of the body. The horns

are fine, somewhat long, and turned upwards at the points. The skin is soft, unctuous, and of a fine orange tone, which is visible about the eyes, the ears, and the muzzle. The milk is peculiarly rich and well-flavoured; and the quantity yielded even on hard fare, is so great, that the Kerry has been styled the poor man's cow. In colour, size, and shape, the Kerry bears a great likeness to the mountain cattle of Wales, and to those of Brittany, in France. The beef of Kerry cattle, like that of all mountain breeds, is tender and juicy, and commands the highest price in the market. Improved breeds come to maturity earlier; and if the meat be not equal to that of mountain-cattle, the loss in quality is more than made up in increased quantity.

III. ON THE REARING OF CALVES.

203. The health and vigour of a full-grown ox depends greatly upon the food and care it receives when young. If badly fed and cared while young it cannot be expected to become a profitable beast.

204. The cow goes in young nine months. A month or six weeks before calving she should be run dry. If the cow be milked up to the time of calving, the calf must suffer, the udder does not spring fully, and the cow herself will not yield the full quantity of milk that season.

205. After calving, the cow should get a warm bran mash, or white drink of some kind. For a day she should be fed principally on soft food.

206. Many farmers allow the calf to suck its dam for some days, believing it to be most natural and best for both. Other farmers, again, who separate the calf from the cow at once, say, that if they are allowed together for some days, the cow not only becomes quite restless when the calf is removed, but goes back in her milk in consequence.

207. The calf should get its dam's milk until it is fit

for dairy purposes. New milk being the most natural food for calves, should be supplied to them for about three weeks. An ordinary sized calf consumes about six quarts of milk daily for this period. It is sometimes given in two, and sometimes in three or more feeds daily.

208. Farmers are aware, to their own heavy loss, that great numbers of calves die every year; and the loss arises principally from bad food and want of care in feeding. When the food is deficient in quantity or quality, the calf is liable to disease; and want of care and irregularity in feeding produce disease of the intestines, which is the most common cause of the mortality of calves in many parts of the kingdom.

209. It is found very expensive to continue giving new milk to ordinary calves any longer than three weeks. Various substitutes are used, skim-milk being the most common. Gruel, made from both linseed and linseed-cake, and hay-tea, are also used. In providing a substitute for new milk, two things should be observed: first, as new milk is the food intended by nature for the calf, we ought to imitate as far as possible, the proportions in which the several nutritive constituents exist in it; and, secondly, we must provide a food which the young animal can assimilate.

210. Skim-milk contains a great deal of the flesh-forming material, as well as of the sugar and mineral matter of new milk, but it is deficient in fatty matter; in other words, the nutritive constituents do not exist in it in proper proportion.

211. It may therefore be assumed that calves could be reared more cheaply by substituting for some of the skim-milk, gruel made of some food rich in fat-forming and heat-giving material, than by feeding them on skim-milk alone. Linseed jelly, in moderate quantity, is excellent food for calves; but if given too freely it is apt to purge them. The small farmers of Ireland should carefully preserve the seed of the flax plant for

the use of their calves. It is made into jelly by first moistening it in cold water, and afterwards pouring hot water upon it in a common bucket, and covering it with an old sack, or a piece of old cloth, to keep in the heat, taking care to stir it occasionally, and cover it up again. When the farmer has no linseed of his own he can buy linseed-meal in the shops; and where the meal cannot be had, linseed-cake may be broken fine and made into gruel.

212. Hay-tea, obtained by boiling some good hay in water, may also form part of the food of calves. We have had ample experience of the value of this beverage in rearing calves. It is used in many parts of the country by the small farmers, who often, however, make the mistake of relying too much upon it. A mixed diet, composed of skim-milk, jelly made from flax-seed or from linseed-oil cake, and hay-tea, and some ground corn, is a good substitute for new milk. In many parts of the country oatmeal is a favourite food for rearing calves; we have found a mixture of oatmeal and wheat flour better than oatmeal alone. *Carrigan* moss has also been used with advantage by many persons in the rearing of calves.

213. When the calf is a month old, it should be gradually accustomed to dry food. Mangold-wurzel (of which calves are very fond), or turnips cut up into thin pieces, should be given in troughs; and oil-cake, finely broken, should be placed within the reach of calves. A wisp of sweet hay should also be suspended in the calf's crib. This the calf will first lick or suck, and afterwards eat. As it eats more and more of dry food, the quantity of liquid food should be decreased; and at about the age of four months liquid food may be withdrawn altogether.

214. Calves are in the habit of sucking each other, especially when, owing to carelessness in feeding, or other causes, their digestion is out of order. As this is injurious, it should be prevented by confining each

calf to a separate crib for about six weeks, when there is accommodation enough for it, or by putting nets or baskets on their heads when allowed to run together.

215. As young calves differ greatly in their habits, we ought to study the peculiarities of each. We should, for example, see that those who drink slowly get ample time and are not disturbed by the others. For this reason, as well as for that just mentioned, some farmers, who allow their calves to run together, tie them up at meal-time.

216. Calves are liable to several diseases which are in a great measure prevented by providing them with adequate food, serving it out at regular intervals, mixing it well, when composed of different materials, never giving it to them too warm, avoiding sudden changes of food, and by keeping the animals clean, dry, warm, and quiet.

217. Many breeders continue to feed the calves in yards, after the liquid food is withdrawn, and give them, during the first summer, green food (such as vetches, corn, or grass), with some hay and cake. This system answers very well when the farmer has good offices and sufficient capital. When calves are weaned from liquid food, they should be allowed to run into a clean, well-sheltered paddock, in which there are hanging trees to shade them from the sun; and provided with suitable feeding, such as vetches, clover, hay, cake, and ground corn, according to the season and the quality of the grass.

218. As winter approaches, calves require to be carefully housed, and generously fed on good oat, straw or hay, with a little roots. If the farmer should be short of roots, a pound of ground corn given to each daily, with a little flax-seed meal, during the winter months, will aid him in bringing his stores to grass in good condition next season. In the second summer they are put to grass; in the second winter they are put on fodder and roots, as before.

219. Short-horns, or good half-bred stock intended for the butcher, are at this age put on a fair allowance of food for fattening. Those which are not forward enough for this purpose are to be regarded as stores.

IV. THE FEEDING OF MILCH COWS.

220. In Great Britain there are about two millions of milch cows, and in Ireland upwards of one million. For want of skill in producing animals of the right description, of proper shelter in winter, and of proper care and skill in feeding them throughout the year, the average return from these cows is 3*l.* per cow less than it could be made.

221. Milch cows should be fed principally in the house during winter, being allowed the run on grass every fine day. In the house they should get some roots, the allowance depending on the quantity of milk they give. House-fed cows in full milk should get three feeds of roots in the day—one in the morning, a second at mid-day, and a third in the evening. In the morning they should get a little more than at any other feed, owing to the long interval between the evening and morning feeds. When the daily allowance is eight stones, three stones may be given in the morning, and two and a half at the mid-day and evening feeds. The cow requires hay at night, and also between the meals. In a few districts chopped furze is given to cows in spring, the tender part of the plant only being used.

222. The troughs of all house-fed cattle should be kept clean, and free from the taint of stale food.

223. In summer dairy cows are grazed on all large farms. On many well-managed small farms in the United Kingdom, and on almost all small farms in Belgium, they are house-fed; while, again, on many small farms a mixed system of grazing and house-feeding is adopted.

224. A great deal has been said on the merits of house-feeding in summer, or on what is called the "soiling system." We believe that there is no system which gives so great an income to the small farmer, so long as the extra labour which it involves comes from his family; but when all the labour of cutting and carrying the grass, and of feeding the cows has to be paid for, the farmer finds a mixed system of soiling and grazing, or grazing exclusively, more profitable.

225. The "soiling" system has been followed with great success by the small farmers of several European countries. It is peculiarly well adapted to the circumstances of the small farmers of this country, more particularly those small holders who have within their own families the labour for carrying it out. It takes from an acre and a half to three acres of the pasture in the hands of many of our small farmers to feed a cow during the summer season; say from the 1st of May to the 1st of November. By putting the same land under a judicious rotation of crops, and growing artificial grasses, a far greater return is obtained. On good land a statute acre of one-year-old artificial grass —rye-grass or clover, or a mixture of both—will give three cuttings, weighing about twenty tons, in the year; and this will supply green grass or "soil" to two house-fed cows for about six months. If there is a piece of vetches for summer use, part of the grass can be made into hay for winter use.

226. Milch-cows, house-fed in summer, should get three feeds of grass in the day. The morning feed in summer should be given at an earlier hour than in winter. The hour for feeding in the evening may also vary with circumstances. From eight to ten stones of grass in the day are given, according to the size of the cows. This would keep them in good milking condition, and if it is desired to fatten them, a few pounds of cake or ground oats and some hay may also be given.

227. Cattle, house-fed in summer, may get exercise for an hour or two daily. If they have access to a piece of pasture, they will eat less grass in the house. The five or six acre farmer who wants to make the most of his holding should have as little permanent pasture as possible; but a small enclosure in which to exercise his cows is very useful. The small farmer who holds over ten acres of arable land should have a piece of permanent pasture for the same purpose, say half an acre to each cow. When the five-course rotation is adopted, the cattle could be fed in the house on the first year's grass, and let out to graze on the second year's grass, if there are fences. A partial system of house-feeding, or a mixed system of house-feeding and grazing, is the best for farmers holding about twenty acres of arable land.

228. Under a mixed system of this kind the cattle could be fed in the house morning and evening in the early part of summer and autumn. At midsummer it would be better to confine them to the house during the heat of day; and to put them out on pasture in the evening, and bring them into the house next morning.

229. The small farmer who house-feeds in summer should have some vetches, lucern, sanfoin, rape, or cabbages, or all five, to supplement the grass, and to enable him to make hay for winter use. Milch cows like a change of food; and besides, in bad seasons, or at particular periods even in good seasons, the grass becomes scarce. This often occurs between the first and second cutting of the grass, at which juncture it would be well to have a plot of vetches. Whenever cattle are suddenly changed from one kind of soft food to another, as, for example, from grass to roots, they are liable to scour. The obvious means of preventing this is to change the food gradually, and to give a sufficient quantity of straw or hay.

230. When either roots or artificial grass are scarce,

cows can be made to keep up their milk and condition with the aid of artificial food, or what may be called hand-feeding. There are three periods in the year at which this species of feeding is likely to be required. The first is in spring, after the roots are consumed and before the grass is fit for use. The second occurs in dry summers, about the middle of July; the third is in the end of autumn, when the grass is scarce, and the roots not yet matured. The kinds of artificial food to be used at these critical periods will vary with prices, with the district, and with the value of milk. Cotton-cake may often be used with advantage. Many farmers give bean-meal to dairy cows. Mashed or cooked food increases the flow of milk, but the butter from this sort of food is generally pale in colour and deficient in flavour. Any deficiency in the quality of milk or butter from cooked food, or from what is commonly called "hand-feeding," is generally counterbalanced by the increased quantity obtained. Owing to a scarcity of grass or roots, the cottager and small farmer must often resort to hand-feeding; and we know more than one instance in which a milch cow is maintained throughout the year principally on this sort of food. Near large towns and cities, distillery or brewery grains are used for feeding milch cows, and are found to produce a great flow of milk which is generally thin. As cows fed exclusively on grains milk freely and are apt to lose condition, it is necessary to use along with them some other feeding materials. When stored in pits, mixed with a little salt, and the air excluded, grains can be kept for several months.

231. Bran is good food for milch cows. It is made into a mash by mixing it with hot water in a vessel or vat, breaking any lumps that may collect, and allowing it to remain in the vessel, under cover of some kind, for a couple of hours. Used alone, however, it is not substantial enough; hence cabbages or

vetches, chopped into small pieces, may be mixed with the bran before adding the hot water. If nothing else is available, cut hay or straw, and a little oil-cake or Indian-meal stirabout, broken fine, may be mashed up with the bran. The mixture may be allowed to remain in the vat until it begins to ferment, when it should be used.

232. We have often in summer given a mixture of chopped cabbage, chopped vetches, and of the artificial foods named, to dairy cows. And more than once we have in October, when feeding of all kinds was scarce and dear, added artificial food to the leaves of mangold-wurtzel cut with a machine.

233. The utmost regularity should be observed in the hours of feeding house-fed milch cows. When the hour of feeding arrives they become anxious, and if not fed then they become restless, and go back in their milk. House-fed cows require also to be cleaned and wisped once a day. In order to keep the air pure, and the cows themselves clean, the byre should be cleaned at least twice a day.

234. Fresh clover is apt to produce swelling or *hoove*. Cattle have frequently died from the effects of eating a full feed of wet clover; and we have seen cattle in very great danger from a large feed of soft Italian rye-grass. To prevent this, the clover or grass should be cut some hours before it is required for use. In the heat of summer, the evening's feed should be cut in the forenoon, and the forenoon's feed the evening before. The necessity for this precaution is greatest after rain. When grass, fresh from the scythe, is thrown into a heap, as it frequently is, near the byre, it soon heats, and its feeding value is thereby diminished. Partly for the purpose of preventing this, and partly also for keeping the grass clean, it should be spread on a platform of wooden spars, so as to raise it a few inches above the ground.

235. The greater part of our dairy produce is

obtained from the milk of cows fed on grass during the summer months. The animals are put out to grass when it is fit to support them. The time varies with the climate.

236. Poor, dry ground, which gives hard herbage, does not make suitable pasturage for dairy cows. Rich, cool land, which gives sappy grass, answers admirably for the purpose. Dairy cows require an abundant supply of good water. Accordingly, low-lying lands are generally devoted to dairy stock.

237. The ground should be kept as clean and as free from noxious objects of all kinds as possible. The presence of common garlic in the herbage is objectionable, as it imparts a bad flavour to the milk. The prevalence of the common buttercup, on the other hand, is regarded with favour.

238. The land should be well fenced, and laid out in suitable divisions. Hedges should be dressed, and ditches cleared out during winter. The material taken out of the ditches should be spread on those parts of the land which require it most, or made into a compost for subsequent use, and not allowed, as is commonly done, to remain on the brow of the headland, obstructing the passage of surface-water into the ditches. The headland should rather incline towards the ditch, to facilitate drainage.

239. When the cows go out first in the season they should be put on the most forward of the grass-fields intended for them; and they should be shifted from field to field as occasion requires, and as will be explained in the section on fattening stock.

240. It has been already suggested that dairy cows require an abundant supply of water. If this be not supplied by rivers or natural springs, a pump or pumps must be sunk at suitable points. In some cases the Abyssinian pump has been used with advantage.

241. It often happens that, for the convenience of the milkers, cows are walked long journeys morning

and evening. This is objectionable, and ought to be avoided as much as possible; for it not only diminishes the secretion of milk, but has an injurious effect on the quality of that which is yielded.

242. There are extensive tracts of poor dairy land in England, Scotland, and Ireland, which would be improved by top-dressing them with bone-manure and suitable composts. In many cases the most profitable course would be to break up these lands, to crop and manure them for a few years, and lay down to grass again in good condition.

243. Many of the cows of the ordinary dairy farmers of this country are dry in winter, and often fed exclusively on hay. The system is generally attended with waste. In place of part of the hay, a small allowance of roots, say from one to two stones per cow per day should be added, to help to keep the system of the animals in proper tone.

V. ON DAIRY MANAGEMENT.

244. Milk newly drawn from the cow has a temperature of about 90° F., which is reduced before it reaches the dairy. It has almost always a slightly alkaline taste, which it gradually loses on exposure to air. It contains, in every 100 parts, about 87 parts of water, 4 parts of fatty matter or butter, 5 parts of a peculiar kind of sugar called milk-sugar, $3\frac{1}{4}$ parts of cheesy matter or curd, and $\frac{3}{4}$ of a part of mineral matter. "Butter gives it an oily richness, sugar its sweetness, curd its thickness, water its refreshing properties as a drink, and salt its peculiar flavour."

245. Milch cows of a good description give each an average of from 500 to 600 gallons of milk in the year. Of the 3,000,000 dairy cows in Great Britain and Ireland it has been estimated that the average yield does not exceed 300 gallons per cow per annum.

That this could be considerably increased by the means already suggested does not admit of doubt.

246. Dairy business divides itself into two great branches; namely, butter-making and cheese-making. The proper management of either requires much skill and care. The relative advantages of the two systems depend on soil and climate, on the demand for butter and cheese, on proximity to markets, and on other circumstances. In many parts of England, and in parts of Scotland, cheese pays better than butter. In other parts of these countries and in the whole of Ireland butter-making is preferred. In explanation of the fact that cheese-making is not practised in Ireland, it may be stated that in most districts the farmers prefer an article like butter, which commands a ready sale, to one like cheese, which requires to be stored for months before it is brought to market.

247. We shall offer some remarks on both branches of agricultural industry, premising, that as our object is to instruct the masses, our observations are not intended for those who already occupy a leading position in the practice of either.

248. We shall begin with butter-making. For this purpose a dairy usually consists of two apartments; namely, the kitchen or working room, and the milk room or dairy proper; but inasmuch as the majority of the tenant-farmers, to whom we address ourselves, have the dairy attached to their dwelling, the common kitchen answers for the dairy kitchen or working room; and if, in addition to this, a suitable apartment were provided for the milk, first-class butter could be easily made. In small-farm districts milk is too frequently kept in a bedroom, or some other apartment equally unsuited for the purpose. It is well known that milk is easily tainted. The foul air of a bedroom is sure to prove injurious to it, and so is the damp which exists in the air, where the house is badly drained, or

where the floor is made of clay, or of material which absorbs and retains a large quantity of water.

249. It is found by experience that the best temperature for a dairy is from 56° to 58° F. It is difficult to keep the temperature of a dairy which faces the south, and is exposed to the influence of the sun's rays, down to this degree during the heat of summer. It is usual, therefore, to give the milk-room or dairy a northern aspect; but if the situation be exposed, it should be protected by trees from the winter's blasts. The small farmer's house and offices are usually thatched in several parts of the kingdom, and when a thatched dairy is ceiled, it answers admirably. As straw is a worse conductor of heat than slates or tiles, it keeps the dairy warm in winter and cool in summer; but unless the house is lofted or ceiled, pieces of straw, and the dirt which collects in the thatch, are continually falling into the milk. Another, and a very strong objection to this form of roof is that the thatch is not durable. The floor of the dairy is made of clay, bricks, tiles, wood, and flags. Clay is most objectionable, because it absorbs and retains moisture. Tiles are expensive; they are also too porous, and absorb and retain too much moisture. Bricks are still worse. Wood is also expensive, and retains milk and wet in its pores, which predisposes it to rot; and no sooner does it rot than it contaminates the air and taints the milk. Good, *hard* flags, carefully set, and made plane on the surface, make the best floor for the farmer's dairy. Flags are to be had within reasonable distance everywhere. They do not absorb much wet, and if well set they are very durable. Whatever material is used, the floor should be well drained, and raised a few inches above the level of the ground outside.

250. Several contrivances have been adopted for the purpose of regulating the temperature of dairies. The small farmer, who can afford little or no extra

outlay for such a purpose, keeps the milk and cream in winter as near the fire as possible, and in summer in a cool out-office, such as a barn. On large farms the proper heat can be easily kept up in winter by circulating hot water in metal pipes, the same as in hot-houses. In the best-regulated dairies we have seen the milk coolers are immersed, summer and winter, in troughs of cold water, which, as is well known, is not as liable to changes of temperature as the air.

251. Milk is greatly injured by the least impurity in the air. The milk-room should, therefore, be well ventilated. It is found that strong currents of air are injurious to milk; and these are prevented by making the milk-room as lofty as possible, and by admitting fresh air as high up as can conveniently be done. The small farmer, whose means are limited, may at first ventilate his milk-room by having one or more of the window-panes on hinges.

252. To make good butter, it is necessary to have not only a suitable dairy but also proper dairy utensils. Of these, the pans or "coolers," in which the milk is set, first require attention. They are made of different materials. Wood is the most common. It is also the most durable, and, on the whole, the cheapest. The staves are usually made of oak; and they are bound by iron hoops, which should be galvanized, so as not to require scrubbing. Whatever material is used, the vessel in which milk is set for cream should be shallow, because if there is a considerable depth of milk, the cream takes a longer time to rise than is desirable. From our own observation we should say the depth of milk in the cooler should not exceed four inches, and the depth of the cooler itself should not exceed five and a half inches.

253. An objection to wooden coolers is the difficulty of cleaning them. Milk adheres to the pores of the wood, and is also liable to lodge at the juncture of the sides and bottom; and if this is not most

carefully removed, the butter will suffer. In everything connected with the dairy, cleanliness should be most rigidly observed; and this applies to the floor, walls, and ceiling of the dairy, and to the milk-vessels and other utensils, as well as to the dairymaid herself. All tainting matter is removed from wooden milk-vessels by washing them with warm water, and cleaning out the sides of the bottom with a sharp-pointed piece of wood. After being partially dried the sides and bottom should be rubbed very hard with a hair brush, and then rinsed, afterwards boiling water is put into them, and they are rinsed again in cold water before being used.

254. Milk is also set in vessels made of common earthenware, which are cheap and easily cleaned. They are generally glazed inside; and if the glazing be well done they answer very well; but, as in the case of Scotch ware, it is often put on so badly that it peels off under the action of hot water, and injures the milk; Staffordshire ware is usually free from this objection.

255. White enamelled ware is sometimes used; it is easily kept clean, the enamelling or glazing does not usually give way; but it is rather costly for small farmers: a pan about sixteen inches diameter, and of the proper height, costs 4*s.* 6*d.*, being about twice the cost of wood.

256. Glass has been recommended by amateur farmers. It has all the advantages of white-ware, looks remarkably nice and clean, but for ordinary use it is too dear and easily broken.

257. Milk pans are also made of metal. Lead is too dear; and it unites with the acid of milk, of which a little is liable to be found, forming a poisonous salt. This objection applies, though in a less degree, to zinc. When the milk is skimmed at the proper time, little or no acid exists in it, but as other materials answer every purpose, it is needless to run any risk by using

these metals. Metallic milk-vessels are sometimes enamelled on the inside to obviate the danger arising from the use of metal. We have used milk-pans prepared in this way, and nothing could be better as long as the enamelling lasted; but when hot water is used in cleansing them, the enamelling soon cracks, owing to the expansion and contraction of the metal. Galvanized iron answers very well; and tinned iron is excellent. Coolers of the latter material, made in Birmingham, and capable of containing four gallons of milk, can be had at present for about 3*s*. each.

258. In these countries butter is obtained from milk by churning either the cream or whole milk. The quality of the butter is influenced more or less by the kind of churn used and the time occupied in churning. In order to know the merits of the several churns in use, as well as to be able to direct the operation of churning, it is necessary to understand the nature of milk and cream.

259. When we examine milk with a microscope we find a vast number of fatty globules or little sacs floating in it. Some of these are cheesy, but the great bulk of them contain fatty matter, or butter. When milk is allowed to stand (as in coolers), the fatty sacs or globules rise to the surface, forming cream. "Some of the cheesy globules have a tendency to descend, but some of them adhere to and rise with the others, so that cream does not consist solely of fatty matter. A portion of the sugar of the milk rises also with the cream. It is owing to the presence of this sugar that cream soon becomes sour. The proportion of cheesy matter in cream depends on the richness of the milk and the temperature at which the milk is kept during the rising of the cream. In cool weather the fatty matter will bring up a larger quantity of curd and form a cream richer in cheesy matter."

260. Churning consists in breaking up the coats of the fatty globules, and setting the fat or butter free;

and this is effected by the combined action of friction, heat, and air. It is in the proper combination of these three agents that the perfection of churning consists. When the friction is too violent the butter is produced too speedily, is deficient in colour, and does not keep well. Heat facilitates the process of churning. If the temperature is too low the time and friction consumed in churning are so great that the butter becomes soft, is deficient in colour and flavour, and does not keep well. We have found from 56° to 58° the best temperature at which to put cream into the churn, and during churning it rises from 2° to 4°. The proper temperature can be increased in a variety of ways; as for example, by immersing the vessel containing it in cold water in summer, and in hot water in winter.

261. The influence of air on the time consumed in churning, as well as on the quality of the butter, is not as well understood as it should be. The oxygen of the air oxidizes the coats of the fatty globules, and thus acts in setting the butter free. In the atmospheric churn, the butter is produced by pumping air into the milk. Whatever churn is used, it should not therefore be filled with cream or milk. In the barrel churn, it is necessary to leave one-third of it for air. When the churn is quite filled it is almost impossible to produce butter. We have known ignorant people who, having filled the churn with cream, and finding that the butter could not be produced, ascribed the result to some evil influence exercised over them by a neighbour!

262. The churn most commonly used by ordinary farmers is the *plunge* or *upright* churn. The friction is produced in this churn by a *dash*, which is moved down (hence the name plunge) and up by a vertical rod to which it is attached. There is a lid (through which the rod passes) for preventing the milk or cream, as the case may be, from splashing. It is worked by

hand on small farms, and often by horse, water, or steam power, on large holdings.

263. The *plunge* churn is cheap, and the quality of butter produced by it is excellent. The time and labour consumed, however, are considerable, especially when, as in the north of Ireland, the whole milk is churned.

264. The *barrel* churn is, on the whole, in greater favour with dairy farmers who churn cream. At the proper temperature, and with the proper quantity of air, it will churn cream in about half an hour. The ends of the barrel rest upon a frame, and the barrel is made to revolve by a handle which is fixed at either end. The wheel should be heavy, so that by its weight or momentum it would (like the fly-wheel of a steam-engine) steady the motion. Barrel churns can be had in all the towns and cities of Ireland. One of the best barrel churns in use is Tinkler's, which is made of well-seasoned oak; the axis rests on "friction rollers," by which the friction or labour of turning is reduced very much; the plug for admitting air has a strong elastic spring, by pressing which air is admitted without the necessity of completely stopping the motion.[1] There is, in the middle of the barrel, an opening for putting in the cream or milk, for taking out the butter and buttermilk, and cleaning the churn. This opening must be large enough to admit the hand.

265. The barrel churn is sometimes objected to on the ground that it is difficult to clean; but in practice the difficulty is not so great as may appear. By pouring warm water into it, and turning it in opposite directions for a short time, the rinsing of it is greatly facilitated. It is durable, not liable to go out of order, and is, on the whole, a very good sort of churn.

[1] Mr. Tinkler recommends to press this spring or air-valve once for every five or six revolutions of the barrel, for a few minutes at first; and afterwards the valve is pressed at somewhat longer intervals.

266. A churn which, from its shape, is called the *box* churn, is also used. The inside of the bottom of the box is semi-cylindrical, the axis is horizontal, and carries the beaters, which revolve with it. Improvements have been made in the box churn in America, where it is used very much. The beaters consist of two pieces of wood placed at right-angles. Sometimes they are all perforated; sometimes only one-half is perforated. Sometimes, again, one side of the dasher contains a number of cells, presenting the appearance of a honeycomb. In this case, and indeed in all box churns, butter is produced in ten minutes, and occasionally in less time. The churn is filled to the axis, and air passes freely through openings in the lid. A great objection to this churn for general use is, that the work is done so speedily that the butter does not keep long. When the butter is used fresh, it answers remarkably well. Hence we recommend it to those who keep a cow or two for family use.

267. Various methods have been proposed for determining the quality of milk, some of which are too refined for ordinary farmers. A very simple instrument, called a *lactometer*, enables us to determine the percentage of cream in milk. This instrument is a narrow glass tube, graduated from the top downwards to about one-fifth the entire depth. By allowing the milk to rest a sufficient time in this instrument, the percentage of cream is shown on the graduated part of the tube. The comparative quantity of cream in the milk of different cows, or of the same cow under different treatment, is shown in this way; but it is not safe to rely on the lactometer as an absolute test of milk.

268. Another instrument which is found useful in testing the quality of milk is the *hydrometer*, which is dipped in the milk, and depends on the principle that as milk is heavier than water in the proportion of 103 to 100, the poorer the milk the deeper the instrument

sinks in it. This instrument is, then, to some extent, a test of the extent to which milk is adulterated with water. It is not, however, a satisfactory test of the quality of milk. Thus, as cream is lighter than milk, it is evident that milk deprived of its cream is heavier, and would give a higher specific gravity than pure milk. By the use of both lactometer and hydrometer, we can judge very fairly of the quality of milk.

269. The business of the person who has charge of the dairy begins in the cow-house. She should milk the cows quite dry twice a day, morning and evening. If any milk is left in the udder, it will be absorbed into the system, lessen the secretion of milk, and cause the cow to go dry. Cows should be milked at the same hours every day: if milked at irregular hours, they become restless, refuse to give the full quantity of milk, and go dry sooner than they otherwise would. Another reason for milking cows quite clean is, that the "strippings," or milk last drawn, is the richest.

270. Before commencing to milk, any dirt which may have collected on the udder should be removed.

271. As soon as the cows are milked, the milk is carried to the dairy; and the less it is stirred in conveying it the better, as milk which is agitated much is injured in quality.

272. As milk newly drawn from the cow usually contains hairs, it is passed through a fine strainer before using or setting it for cream. In the latter case the strainer should be held over the cooler as the milk is poured into it. When set for cream, the milk remains undisturbed till all the cream rises to the surface; the time required for this varies with the temperature and the depth of the cooler. At a temperature of 56° milk is fully creamed in twenty-four to thirty hours. At a higher temperature it takes a shorter, and at a lower temperature a longer time. "At 34° to 37° milk may be kept three weeks without

throwing up any notable quantity of cream; but at a temperature of 65° and upwards it throws up its cream freely, and sours rapidly."

273. The cream, having risen to the surface, is removed by a skimmer, which is a hollow scoop of wood or metal; and poured into a deep vessel called a cream-jar. The greatest possible care should be taken to remove the cream before the milk sours, for the "cream of sour milk never makes good butter." The cream is allowed to ripen, or acquire a slight degree of sourness in the jar, which facilitates the churning, and does no harm to the butter if not permitted to go too far. The time the cream takes to ripen depends on the temperature; in well-managed dairies it is allowed to remain two or three days, the temperature being 56°. The dairymaid knows when the cream is ripe for churning by its becoming thick throughout its entire mass.

274. If the cream of one meal or milking is enough to make a churning, it is kept separate; if not, the cream of several meals is put into one jar; and after fresh cream is put into the jar the whole should be stirred with a clean wooden stick.

275. When the cream is ripe it is put into the churn. The motion of the churn or dash should be somewhat slow at first, say thirty-five revolutions per minute, in a barrel churn of average size; it should be gradually increased till the cream is slightly broken or gets thinner, when it is increased to about forty or forty-five revolutions per minute, at which it is continued till the globules are well broken, and this is known by the unequal resistance offered to the dash or beaters; the motion is then slackened to collect the butter. The collection of the butter is, in a barrel churn, facilitated by turning the churn backwards and forwards for a few minutes. When the butter is all collected, the buttermilk is drawn off, cold clean water is put into the churn, and the barrel is turned round to wash it out.

276. Where whole milk is churned, it is allowed to remain in coolers till it acquires the temperature of the dairy, which requires twelve hours, and sometimes twenty-four. Two or three meals or milkings are then put into a large vessel, where it remains till the whole acquires a slight degree of acidity, without which it could not be churned. The precise stage at which to churn is known by the appearance of a stiff *brat* upon the surface of the milk, which becomes uneven. This takes place in about thirty-six hours, more in winter, and something less in summer. The circumstance of all the milk not being of the same age does not affect the quality of the butter. The brat should not, on any account, be broken till the milk is put into the churn, as the admission of air would, by producing too much acidity, prove highly injurious. We require a higher temperature for churning whole milk than cream. The best temperature at which to commence churning the former is 65° F.; and this temperature is easily attained in summer by immersing the vessels that contain the milk in cold water, and in winter by placing them in hot water.

277. As soon as the butter is fully formed it is taken out of the churn and dressed. The dressing of butter requires great care and skill. It is done in a cooler or butter-tub specially made for the purpose, which requires to be kept most scrupulously clean. It is washed with the purest water that is to be had, and cut up with a butter-spade, or broken by the hand, to facilitate the escape of the milk. When the water becomes milky it is removed, and fresh water added; and this is repeated until the water comes away quite free from colour, for if every particle of the butter-milk is not removed the butter soon becomes rancid. The inferior quality of an enormous quantity of our salted butter arises from want of care in washing it. Butter-milk, particularly that obtained from whole milk, contains caseine or cheesy matter, and if

much of this remains in the butter it soon engenders rancidity.

278. After the butter is thoroughly washed, common salt is added to it. Salt has the valuable property of preserving animal substances from putrefaction. The quantity of salt added to butter depends on the length of time it is intended to be kept before using it. Butter used in the fresh state, or within a short time, requires very little salt. For the London market our best dairy farmers use three-quarters of an ounce of salt to every pound of butter. Many people prefer a mixture of half an ounce of salt, a quarter of an ounce of yellow Jamaica sugar, and one-eighth of an ounce of nitre, to salt alone. Butter intended for the Colonies or long keeping requires about an ounce of salt to every pound of butter; and, in addition, sugar and nitre in the above proportions are sometimes added. The butter called *mild-cured* is made by mixing a pint of salt to every quarter cwt. of butter.

279. Cattle fed on roots, more particularly swedes, yield butter of which the taste and flavour are disagreeable. By giving the turnips to the cattle immediately after milking, the substance which imparts the bad flavour to the butter is removed out of the system, or reduced in quantity, before the next milking; and any that remains is destroyed by putting a little nitre in the milk-pail; and in this case no nitre need be added to the butter in salting it.

280. The salt, or mixture of salt and sugar, or of salt, sugar, and nitre, requires to be thoroughly mixed with the butter. The hand is usually employed in doing this, as well as in working the milk out of the butter. Some object to the hand, alleging that the oily matter secreted from it injures the butter. The secretion of this matter is so copious in some persons that their hands should not be used in dressing butter; and if they have to be employed at all they should be called on to use the butter spade. The

female hand is, however, usually very delicate; and, as dairymaids should be persons of cleanly habits, the hand may, in most cases, be safely used. At the same time, we think the cleanest dairymaid may partly use the spade, no matter how delicate her hands; and, while dressing butter, she should occasionally dip her hands in clean cold water.

281. As the quality of the salt affects the quality of the butter, it should be procured from a respectable vendor, who is known to keep a fine article fit for the dairy. It should be free from the soluble salts of magnesia and lime, and other impurities. "Salt is rid of its impurities by pouring boiling water upon it, in the proportion of one quart of water to from half a stone to a stone of salt, stirring the whole occasionally for a couple of hours, and then straining it through a fine clean cloth. The water which passes through contains all the impurities, and may be used for ordinary culinary purposes, or mixed with the food of live stock. The salt which remains on the cloth is free from the soluble salts of magnesia and lime, and may be hung up in the cloth till required for use."

282. Butter which is to be used fresh is made into prints or rolls; and if required for long keeping or export, it is packed in kegs, firkins, or casks. The firkin should be made of well-seasoned wood, and as staunch and air-tight as possible. It should also be subjected to boiling water, and afterwards immersed in cold clean water for forty-eight hours. This prevents the wood from absorbing the pickle which it is desirable to keep about the butter. The extensive dairy-farmer makes as much butter at a time as fills the firkin or cask. The butter is packed tightly into the vessel, is made level on the top, a piece of clean muslin is laid carefully over it, and the whole covered with a tight-fitting lid. The small farmer requires the butter of several churnings to fill a firkin; and from want of care and skill in washing,

dressing, and salting the butter, the contents of the firkin, when bored through by the butter-buyer, often present shades of colour and quality as numerous as the churnings from which it was made up. This lessens the value of the whole; and there is also a heavy loss from want of care in packing the butter. Sometimes a quantity of brine, or a strong solution of salt in water, is poured over the butter, which makes part of it too salt. Again, some people merely cover the butter by putting on the lid; and, as a matter of course, the butter is soon tainted by the air between the lid and the butter. Now, the butter of each churning should be stored compactly in the firkin, and it should be covered on the top with a fine piece of clean muslin, over which an air-tight or close-fitting covering of wood, pasteboard, or parchment should be carefully fixed. When the produce of another churning is to be added, the covering is removed, the butter on the surface scraped away and used in the house, the fresh surface is made uneven, the newly-dressed butter added, and the whole covered as before.

283. It may be well to state, for the information of beginners, that it takes from ten to twelve quarts of good milk to produce a quart of good cream or a pound of butter.

284. *Cheese-making* consists in extracting from milk the caseine it contains, and which is seldom less than 3 per cent. of its weight. This substance is very nearly identical in composition with the flesh or muscle of animals, hence cheese is used largely as an article of diet by the working classes of England. In separating the caseine we obtain along with it some of the fat or butter of the milk, so that cheese does not consist exclusively of flesh-forming material.

285. Caseine is held in solution in milk by an alkali, and the leading principle involved in the manufacture of cheese is to add to the milk some substance which would combine with the alkali, and convert the

caseine into the insoluble body called curd. Any acid substance will produce this effect partially. When milk sours, lactic acid is produced, and, by combining with the alkali that holds caseine in solution, deposits curd, as every person has seen in the process of making whey.

286. The substance most universally used in England is rennet, which is an infusion of the fourth stomach of a calf. The stomachs are prepared in a variety of ways. In the dairy districts of Gloucestershire which we visited, they are "salted, pickled, and dried" a year, at least, before they are required for use. It is found that two skins will suffice to coagulate the milk given by a cow during a season.[1]

287. The quality of cheese varies with the breed of cattle and with their food, but it depends mainly on the mode of manufacture. When a cheese rich in fatty matter is desired, some cream is added to the whole milk, and the rennet added. The cheese known as Stilton is made in this way. The bulk of the cheeses known as Cheddar, Dunlop, Gloucester,[2] &c., is made from whole milk.

288. In some parts of the country the cream of one meal is removed, and the skim-milk added to the next milking, and a cheese inferior in quality obtained from the mixture. Cheese of the lowest quality of all is made from skim-milk.

289. The details of the manufacture of cheese vary in different districts, but the main principles involved in all are the same. The milk should not be permitted to become sour; and as the usual practice is

[1] In Cheshire two bits of skin, each containing two or three square inches, are put into half a pint of warm water, a teaspoonful of salt is added, and the infusion coagulates 50 or 60 gallons of milk.

[2] Gloucester cheese is made of two sizes, called *Single* and *Double* Gloucester. The single Gloucester comes to maturity in two or three months.

to make the cheese in the morning from both the evening and morning's milk, it is necessary, in order to prevent the evening's milk from turning sour in the morning, that the temperature of the milk-room should not exceed the degree already laid down. The morning's milk, too, must be allowed to lose its animal heat before adding the rennet to it. In summer 75° to 80° is a good temperature; in winter 5° more are required. With a temperature from 75° to 80° coagulation takes place in about an hour.

290. As Cheddar cheese brings the highest price in the market, and is fast superseding other kinds in England, Scotland, America, and the Continent of Europe, we give an outline of the mode of making it.

291. The rennet is added at a temperature of about 80°. In an hour the curd is completely formed, when it is carefully broken by hand, or by a machine specially made for the purpose. The whey is then withdrawn by a tap in the bottom of the vessel, and the curd allowed to subside. To facilitate the removal of the whey, the curd is heaped up from the sides towards the centre of the bottom, which is made convex for the same purpose. It remains in this state until it acquires a proper state of consistency, when it is removed to a shallow cooler, where it remains for a time, varying with the temperature, and from which it is put into the press for a few minutes. It is then removed and passed through a hand-mill, which makes it rather fine, after which, when the curd becomes mature, the finest salt is added, at the rate of 1 lb. to every 56 lbs. of curd. It is then vatted, and again placed in the press; next morning it is reversed in the vat, and is covered with a clean, coarse cheese-cloth. On the second morning it is again reversed, and receives a calico cloth; and on the third morning it is taken to the cheese-room, where it becomes fit for market in about two months. The rennet is made by soaking four stomachs, locally called "vells," in four quarts of

water, in which 2 lbs. of salt are dissolved by boiling. This infusion will coagulate the milk of 70 cows during a week.

292. In America the system of co-operation has been introduced, with great success, in cheese-making. The milk of several farms is brought to a central factory, where the best skill and the most approved machinery are used. The cheese brings 10*s.* a cwt. more than that made at separate farms. After deducting expenses the receipts are divided among the co-operators in proportion to the quantity of milk supplied by each. This system has also been adopted in several places in England.

293. In small dairies the best shape of cheese is the loaf, or "truckle," as it is called in the Cheddar district, the diameter being seven and the height ten inches. The weight of such a cheese is from 10 lbs. to 13 lbs.

294. The room in which cheese is placed should be dry. A loft is the best place for the purpose, and the temperature should be kept at from 50° to 65°. If the temperature be too high, the sides of the cheese will sometimes crack; if too low, the evaporation, which goes on at the rate of 2 lbs. per day in every ton of fresh cheese, will be too slow, and the moisture will lodge in and about the rind of the cheese, giving it a pale colour, and deteriorating its flavour.

295. As the whey from whole milk contains some fatty matter, it is set for cream, and this cream is afterwards churned, and made into butter. When the cheese is well made the quantity of whey butter is about 6 lbs. per cow per annum; but when badly made, it may be as much as 30 lbs. Whey butter is worth 2*d.* or 3*d.* per lb. less than butter made from whole milk.

296. Every gallon of whole milk produces 1 lb. of cheese during the best part of the cheese-making

season, but this is above the average of the whole of it. Assuming the average yield of milk from a dairy cow to be 500 gallons per annum, the annual return from it on the Cheddar system may be estimated thus :—

440 lbs. cheese, worth, if well made, 8*d.* per lb.	£14	13	4
6 lbs. whey butter, at 9*d.*	0	4	6
Value of whey for feeding pigs	1	0	0
Value of calf, 10*s.* to 1*l.*, say	0	10	0
	£16	7	10

VI. ON THE FATTENING OF CATTLE.

297. Of the vast number of animals slaughtered in the United Kingdom, a large number are sent to market in very good condition by the graziers, large farmers, and landed gentry. It is well known, however, to persons acquainted with the cattle trade, that a great many beasts are sold in a half-finished state. The loss on these is very considerable ; for, as every practical man knows, beasts pay better for their keep in the more advanced than in the early stage of fattening.

298. The fattening of cattle divides itself into two great divisions, grazing and stall-feeding. The former of these is practised principally upon what, by way of distinction, is called fattening land ; and we think that this is a profitable way of managing this class of land. As a rule, one-third of the animals are put on the land in October, one-third at the great May fairs, and the remaining third during summer. The land usually fattens at the rate of two beasts for every three statute acres. By stocking some first-class land less closely it often fattens two sets in the year. Some graziers give cake in troughs on the grass at the rate of 2 lbs. and upwards per head daily. Crushed oats and ground barley are also used for the same purposes ; and when the price of these crops is low,

and the price of meat is high, it pays very well, if we take into account the improvement which is effected in the land by the dung of the animals.

299. The grazier shifts his cattle from field to field, so that they may always have a good fresh bite. For this purpose his land may be divided into three or four sections. One is kept free from stock until the most forward beasts need it. The cattle are grazing on section two until section one is ready for them. Section three receives the less forward beasts or dairy stock; and store cattle and sheep may occupy a fourth section. The animals are regularly shifted from one division to another. Thus, when the stock in section four is transferred to section three, the former is cleared and closed up till it is ready for the most forward beasts; and so on of the other divisions. It is worthy of remark that, as fattening animals approach ripeness, they require better keep, which, in the case of grazing cattle, means more succulent pasture. Grazing cattle also require a plentiful supply of water. It is found beneficial, as already stated, to place rock-salt within their reach, so that they may lick it. The passages leading from field to field should be kept clean to prevent disease of the feet, which keeps up irritation and wastes food.

300. The fattening of the cattle in houses, commonly called stall-feeding, is carried on during winter and spring. The animals are withdrawn from grass at the approach of winter, and put under shelter. For about ten days after the animals are put up they should get soft turnips, which prepare them for the more nutritive sorts. From the very commencement the strictest regularity should be observed in the hours of feeding, and the beasts should be kept clean and comfortable all through. Some farmers curry them once a day, and we have no doubt this extra trouble pays remarkably well, as it promotes the healthy action of the skin. The house should be warm, but

not so close as to cause sweating, which is injurious. The greatest attention should be paid to the dung, which should be neither too soft nor too hard. When the beasts are put up to fatten the soft turnips generally scour them ; but, if not allowed to go too far, this brings about a healthier action of the entire system, and by providing dry fodder the excrements are soon restored to their proper consistence. The animals may now receive more fattening food, the kinds and quantities of which vary with the size of the beasts and with the views of the farmer. The kinds of food most commonly given to stall-fed cattle are roots, straw and hay, with oil-cake or corn. The state in which it is best to give these substances to cattle is a subject on which opinions differ widely. A few persons advocate the cooking of the roots. The general opinion is, however, that this does not pay. The advocates of the system say the animals can digest their food with less exertion (which means less waste of tissue) when it is cooked for them. Roots are, however, easily digested ; and, besides, the large quantity of *saliva* secreted during the mastication of the raw roots promotes digestion. We, therefore, consider that it is a waste of food and labour to steam or boil roots. To prevent choking, the roots should be cut into slices not exceeding an inch in thickness.

301. Some again reduce the roots to shreds by what is called a pulping-machine, which is serviceable in the feeding of cattle when the farmer wants them to consume and assimilate a large quantity of straw ; that is, for example, when roots are scarce and straw and fodder abundant. By mixing the pulped roots with straw cut into what is called "chaff," by a chaff-cutting machine, cattle can be made to eat a great deal of straw. By allowing the mixture to stand a short time, the fodder is sweetened by the juice of the roots. For milch cows, the mixture ought to undergo a slight degree of acidity, which promotes the

secretion of milk. For fattening animals this is not desirable.

302. When oil-cake is given to fattening beasts it should be broken very fine, and given by itself, or strewed upon the turnips. When a chaff-cutter is used, the oil-cake may be made into a mucilage, and poured upon the cut straw or hay. Or the cake or corn may be added to the mixture of prepared roots and chaffed fodder to which we have referred. For feeding purposes corn should be crushed either at the nearest mill, or by a machine specially constructed for the purpose. The farmer who feeds horses and cattle on oats should have an oat "crusher," to be worked by hand on small and moderate-sized farms, and by water or steam power on large holdings. Every cwt. of oats given to thriving animals (along with roots and good oat straw) produces at least twelve lbs. of beef and tallow. If given to ill-shaped and badly-reared cattle it would not produce so much; but we are clearly of opinion that the beef and manure obtained from the judicious use of oats in cattle-feeding would amount to more than the price at which immense quantities of it have been sold by farmers of late years.

303. Stall-fed cattle should receive three feeds of roots, or roots and cake or corn, in the day,—one in the morning, one at noon, and one in the evening. They should also receive some good oat straw or hay at night. If fed oftener, they are disturbed more than is desirable.

304. The question what are the proper quantities of the various kinds of food which ought to be given to stall-fed cattle, has never been fully answered. The usual practice is to give them as much roots and fodder as they can eat. This system often causes waste and loss. From eight to twelve stones of roots in the day, according to the size and condition of the beasts, may be given to each, together with good straw or hay, and some corn or cake. During the first ten

days or a fortnight, that is, while the animals are on soft turnips, no artificial food is needed, but when put on Swedish turnips, one lb. or two lbs. of corn or cake may be given daily to each, and the allowance may be increased to four lbs. as the period advances.

VII. THE FARM HORSE.

305. There are in the United Kingdom upwards of a million and three-quarters of horses, of which more than one-half are used for agricultural purposes. A large proportion of these do not give an adequate amount of work for the food they consume. They are badly shaped and ill-adapted for farm work. Little care is bestowed on their production, and their feeding, especially while young, is also neglected. It is well to impress on the minds of the future farmers of the country that a horse should not be kept on a farm of five or even of ten or twelve acres unless in special cases. Horse labour is one of the most expensive items of tillage. It is usually estimated that a pair of horses is required for every forty to fifty acres of tillage land of average quality. A horse kept in fair working condition costs, in round numbers, about 10*s.* a week, exclusive of the labour of the ploughman or carter. This gives a charge of at least 1*l.* an acre for the keep of the horse, which shows the necessity of obtaining the greatest possible useful effect from horse power. And this can only be accomplished by keeping a class of horses suited to the work which they have to perform, by feeding and caring them with the utmost skill and economy, and by employing their time to the best advantage. We shall offer a few remarks on each of those points.

306. The breeds of agricultural horses most highly esteemed are the Clydesdale and Suffolk Punch. In parts of the West of England a very useful animal has come into use, called the West-country horse.

307. The first care the horse requires in the morning is to water him, after which he gets his first feed; and when this is eaten the harness is put on, and the day's work begins.

308. When brought home after his day's work, the horse requires careful grooming, more especially in wet weather. If the legs are dirty, it is usual to wash them down by the hand, or to walk the horse through a shallow stream of water. The legs should not be wetted above the knees and hocks; and we should be particularly careful not to wet the belly, for if not well dried afterwards the horse is apt to get inflammation of the bowels. When the horse is watered and groomed he gets his feed. He should be cooled from the heat of the day's work before he is put into the stable; and the necessity for taking this precaution becomes all the greater when the stable is small and badly ventilated. Horses very frequently take cold from sudden changes of temperature. Colic often follows injudicious feeding, such as a sudden change to green food, or taking too much cold water after hard work.

309. The horse's feet should be carefully picked every evening before he is put into the stable. He should also be carefully wisped all over to dry the coat and remove dirt, and afterwards curried and brushed. The farmer who is trusting to others should visit the stable every night after the servants have finished their work. He should see that the animals are properly littered; pass his hand over them to see that they are quite dry, and give them a slap with his hand on one or two points to see that the dirt and dust have been removed.

310. Oats and hay may be said to form the staple food of horses. A working horse should not be fed solely on hay, as the quantity which would afford the necessary nutriment is too bulky. Hay is sometimes so badly saved that it is little better than straw; and

working horses fed on this kind of hay lose condition. Mouldy hay often produces the disease known as broken wind. This disease is often found to be produced by giving too much hay to horses. A very usual daily allowance of food for farm horses is 12 lbs. oats, 21 lbs. hay, with occasional mashes at night.

311. Ground Indian corn is now very generally used in the feeding of hard-wrought horses, such as those employed in omnibuses. When it forms the staple food of animals which are not in full work the disease known as "grease" almost invariably occurs. It should therefore form only part of the food of farm horses, unless they are actively employed. As the work slackens the quantity ought to be reduced.

312. In summer horses get green food, such as cut grass and vetches; and many farmers put their horses out to grass at night during that season.

313. When farm work is slack during the winter months, good oat straw is often substituted, partially or wholly, for hay. When it is intended to use a mixture of hay and straw, it is a very good plan to mix them together in the rick. The dry straw prevents the hay from heating, and the hay improves the taste and flavour of the straw. We should always select the nicest, cleanest, and shortest straw for horses.

314. Of root crops the carrot is the best for horse feeding. It is almost invariably given raw. It imparts a nice glossy coat to the animal. The carrot is, however, too innutritious to be solely depended upon as the food of the working horse.

315. Boiled potatoes are very good for horses; but they are now too dear to be used in this way. Swedish turnips and mangold-wurtzel have been also used. They are too watery to enter largely into the diet of working animals; but a mash of boiled Swedish turnips, or mangolds, mixed with a little salt, may be given at night twice a week, with great advantage.

316. In some light land districts, especially in Wales and Ireland, farmers' horses are fed on furze from October till spring. Only the tender shoots of the plant are used, and they are prepared by being chopped and bruised. A daily allowance of three stone of furze prepared in this way will keep a horse in a sleek and fair working condition throughout winter. Furze alone is not adequate food for a farm horse at full work in autumn or spring; and is not grown except on poor land which refuses to give more valuable crops, on the sides of steep and craggy hills, or when it is planted in the fences. It is estimated that an acre of furze will feed four or five horses for four months.

VIII. SHEEP.

317. It has been estimated that the average value of the sheep in the British Islands could be increased 5*s*. a head in a short time by bestowing proper attention on their production, feeding, and general management; and as there are upwards of 30,000,000 of sheep in the country, this would increase our wealth to the amount of seven and a half millions sterling.

318. It is in regard to the sheep in the hands of the struggling farmers that the greatest improvement remains to be effected. Those animals are frequently ill-shaped, require three years to come to market, and do not weigh as heavily as well-bred and well-fed sheep at the age of fifteen or sixteen months. Food is thus wasted, the farmer's capital is turned slowly, and the profit is extremely small.

319. Sheep are reared for their flesh and wool. The weight of the carcase and the quality of the mutton, as well as the weight of the fleece and the quality or "staple" of the wool, vary greatly with the breed. The longer time a sheep takes to come to maturity the better the quality of its mutton, and

accordingly the mutton of large and fast-growing improved sheep is not as good as that of unimproved or mountain sheep. The Cotswold breed is one of the largest and fastest growing breeds we possess, but the mutton is very low in quality, and sells for one penny a lb. less than good mutton. The Black-faced sheep of Scotland, Welsh sheep and all mountain sheep, give tender and savoury mutton, which always commands the highest price. The mutton of the Southdown breed of sheep is also very good, and brings a higher price than the mutton of the Leicester, and of other favourite breeds.

320. All our breeds of sheep are usually classified into *long-woolled*, *short-woolled*, and *intermediate*, according to the length of the wool. Leicester, Lincoln, and Cotswold sheep, whose wool is fully seven inches long, belong to the long-woolled class. When, as in Southdown sheep, the staple of the wool is from two to four inches, the breed is said to be short-woolled; and the Cheviot and Oxford breeds are examples of the intermediate class.

321. The Merino breed of sheep gives the best wool. Formerly its price was very high; but the price of Merino and other descriptions of fine wool has been brought down, and the price of long wool advanced, by the remarkable change that has taken place in dress. This change consists in the use of a greater quantity of tweeds and other coarse woollen fabrics, instead of the broad-cloth so much worn thirty years ago.

322. The most celebrated sheep we possess is the Leicester, which owes its merit to the labour of Bakewell and other able men, who, by the extraordinary improvement effected in this breed, and by the example they afforded, have contributed largely to the progress of modern agriculture. The old Leicester used to take three years to come to maturity, like some of the unimproved breeds of our own day. The improved Leicester was brought to market at fifteen months old, weighing

21 lbs. a quarter. The breed requires rich and well sheltered pasture. It has been as useful in improving other breeds of sheep as the short-horn in improving other breeds of cattle. But of late it has been found that a sheep of larger size, and with a heavier fleece, is found to pay better in many districts.

323. The Lincoln, for instance, has superseded it in many of the low-land districts of the county of that name, and elsewhere. The Leicester was used in the production of the Lincoln. The latter has, however, a larger frame and a heavier fleece.

324. The Cotswold is a strong upstanding sheep admirably suited to the Cotswold Hills, which are, in reality, extensive plains of elevated land. The soil is well suited for tillage purposes. Systematic cropping is pursued, and a considerable portion of the turnip crop is eaten where they grow. The Cotswold breed answers well for the purpose.

325. One of the oldest of modern improved breeds of short-woolled sheep is the Southdown. The quality of both wool and mutton is excellent. The heads and feet are coloured. Owing to the cause already indicated farmers found that a larger animal would pay better; and accordingly new breeds have sprung up to take its place.

326. The first of these was the Shropshire down, which is now highly esteemed on cold lands like those on which it originated. It is also very generally used for the production of what may be called butchers' lambs.

327. Still more recently the Shropshire down sheep has in some places yielded to the Oxfordshire down, which is an animal of larger frame and longer wool. The Oxford down is a new breed; but it promises to pay well in many places.

328. The Hampshire down sheep is another new breed which, in several parts of the county from which it takes its name, is found to pay better than any other breed.

329. In Ireland a valuable breed of sheep called the Roscommon has been recently established. It has been produced by mixing the Leicester with the native sheep of the West of Ireland, until an animal was produced, which in the opinion of the intelligent flock-owners of that county possessed all the qualities they required. They then established the breed in the usual way. The Roscommon is a large long-woolled sheep. It does not arrive at maturity as soon as the Leicester; but it has a strong constitution, and is possibly the most profitable breed of sheep on the extensive sheep-walks in the West of Ireland in which there is little shelter, and little or no tillage.

330. As a mountain breed the Cheviot is the best we possess. When the situation is too elevated or exposed for the Cheviot the black-faced sheep of Scotland pays better. There is great room for improvement of the mountain sheep of many parts of the country by the exercise of care and skill.

331. Ewes should be made to yean when there is good grass for the lambs. When the farm is exposed, or the climate cold and cutting in spring, lambs should not be dropped early. "Thousands of lambs," says Mr. Youatt, "die every year from the cold to which they are exposed by being dropped too soon. And on the other hand there may be danger and inconvenience if the period of lambing is too late. Hot weather is as fatal to the mother as cold is to the young. It frequently induces a dangerous state of fever; and both the mother and the lamb may then be injured by the luxuriance of the grass. If the lamb falls late in the season, it will be longer ere the ewe can be got ready for the butcher, if she is a draft ewe; and the early lambs become larger and stronger and better able to resist the cold of the succeeding winter. The weaning time will, therefore, be regulated by the situation of the farm, the nature of the pasture, and the demand for the neighbouring markets."

332. As dirt collects in the wool, sheep should be washed in a running stream before being shorn. Many farmers lose very considerably by the filthy state in which they send wool to market. They think that as the dirt adds to the weight of the wool it does not pay them to go to the trouble of washing and preparing it. Common sense should teach them that the buyer will not only cut down the price, according to the impurity of the wool, but make a deduction for the labour of cleaning it.

333. As soon as the lambs are weaned, and the ewes quite dry, the shepherd goes through his flock very carefully, and "culls" or drafts from it as many of the worst of the old ewes as he can replace from the young flock.

334. Pasture is the most natural, as it is the most universal food of sheep. Thousands of sheep never get anything else.

335. In England and Scotland, and on several farms in Ireland, sheep are fattened on roots in winter and spring. Averaged-sized sheep fed exclusively on roots consume about a stone and a half of swedes daily. On this keep a sheep will increase about 5 lbs. a quarter in from four to five months. The increase of the wool in the same period would be about a pound. Roots should be cut and given to fattening sheep in troughs. In this way none of the roots are wasted. By cutting the roots sheep eat more of them and fatten quicker. Roots are not usually cut for store sheep.

336. In addition to roots, sheep, when intended for fattening, get some hay in racks.

337. Many farmers give a little cake or corn in addition. At the present prices of meat and wool we believe it pays fully as well to give artificial food to sheep as to cattle. When given, the cake should be broken very fine, and the oats crushed or "cracked." About three quarters of a pound of oil-cake or a pound

of oats per sheep per day may be given with advantage; and when this is given, along with a good allowance of roots, the period of fattening is shortened about a month, and the sheep turned out in better condition. In this way roots are saved, a greater number of sheep can be fed, more manure is obtained and as a matter of course the land improves in quality; and so long as the farmer does all this judiciously, his own circumstances must improve.

338. In severe winter and spring weather store sheep and breeding ewes should get hay or roots, or a little of both, if they can be spared. Some farmers give artificial food when hay or roots are not available. It is certainly a mistake not to provide sheep with adequate keep at those seasons.

339. Ewes which yean before there is a good growth of grass should also have some roots. Mangold-wurtzel is excellent for this purpose. The allowance of roots must vary with the state of the grass.

IX. SWINE.

340. There are in Great Britain and Ireland 2,500,000 pigs. It has been observed that as many pigs are annually sold as the country contains at the time of taking the Government returns.

341. Assuming the average value of each pig disposed of to be 4*l.*, the agricultural classes derive fourteen millions sterling from the sale of swine, which is a most important item in our national wealth. That this could be increased without any extra feeding is well known to everybody who is acquainted with the state of the country; for while it is true that a great improvement has been effected in the quality of our pigs, much remains yet to be done. One of the most noted pig-breeders in England has expressed the opinion, that by bestowing proper attention on the breeding, rearing, and feeding of swine, the quantity

of meat could be doubled at little more than the present cost.

342. The pig has often been called the poor man's savings' bank, and the poor man's friend. It is beyond all doubt that this animal is of immense advantage to the cottager. A store pig can be purchased at sums varying from a pound upwards. It consumes the offal of the table; and by a small weekly outlay, which might otherwise be spent on tobacco or intoxicating drinks, that weaken mind and body, the animal in a short time becomes worth from 3*l.* to 5*l.*, and often more. It is in this sense that the pig can be correctly regarded as a savings' bank; and when the animal is fairly managed, the poor man cannot invest his savings in any other way that would pay him as well. But besides the profit of the animal, we hold that the feeding of pigs in this way is, in other respects, most beneficial to the people. It engenders habits of forethought and of thrift. The working man, who saves a small sum weekly out of his limited income, and skilfully invests it in feeding a pig or two, is pretty sure to improve his own condition, and to impress the best of all lessons on the minds of his children.

343. Pigs may be classed in various ways. Thus, according to colour, we have black and white; according to size, small, large, and intermediate. As regards size, the farmer must be guided by the demand. A moderate-sized pig suits a cottager best.

344. In deciding on the kind of pig to keep, we must be guided by circumstances. Many dairy farmers, who have a supply of skim-milk and buttermilk find, now-a-days, that a moderate-sized pig of the Yorkshire breed pays them best. This class of animal grows rapidly, and is easily fed. Since the introduction of the use of sugar for "curing" bacon, the degree of fatness in pigs, which was previously so much in demand, is not required. Persons who use their pigs for consuming offal, which is comparatively

innutritious, find a large and slow-growing pig more profitable.

345. The pure breeds most in demand are the Yorkshire and Cumberland, which are white, and the Berkshire and Essex, which are black. The Yorkshire is perhaps most generally used. It is of three sizes, small, medium, and large. The Cumberland is a handsome moderate-sized pig. The Berkshire is recognized by the presence of patches of white on the feet and face, and is a hardy breed. The Essex is a newer breed, and more highly prized in several parts of the east and south-east of England. In Suffolk there is also a valuable breed of pigs.

346. All the improved breeds of pigs possess many points in common; and the more of these points any pig, whether purely bred or otherwise, possesses, the better he is likely to pay. The head is small; the eye small and quick, denoting docility, which is essential for profitable feeding. The neck is broad, rises well from behind the ears, and swells out as it joins the shoulders and breast. The breast is wide and deep. The back should be straight or with a slight curve, broad, and covered with flesh of good quality; the ribs should spring at right angles to the chine. The shoulders are thick, broad, and well covered; and the thighs thick and well covered within and without, and carrying flesh well to the hock. The legs are short, the feet short and round, and furnished with clean claws. The hair is pretty long, fine and silky, and contains few bristles. The skin is thin and supple—neither tight nor loose. The tail is small, curled, and set so that it is not seen at the top when the animal is fat. When viewed from the side, from behind, before, or when a bird's-eye view is taken, the carcase should present the outline of a rectangle.

347. The sow goes in young about 113 days. Making allowance for the time she is suckling her young, she can produce two litters in the year, and when it is

thought desirable, she will give five litters in two years. The first litter is rarely as numerous or vigorous as subsequent ones. Good breeders, who wish to keep up first-class pigs, do not usually breed from pigs of the first litter. A profitable sow has from eight to twelve young ones at a time, ten being a good average. A sow which does not give a fair average number of young ones should be disposed of. A bad nurse, or a sow which eats her young, should also be fattened off as soon as possible.

348. Sows farrow at all seasons of the year. It is, however, difficult to rear young pigs in cold, harsh weather. It appears to us that for the ordinary farmers of this country, spring, and the end of summer or beginning of autumn, are good periods for farrowing. In the former case there will be plenty of milk to spare for the young pigs at the time of weaning, and in the latter case they will be strong before the hard weather sets in.

349. The sow requires great care for some time before farrowing. As the critical period approaches she should be placed in a sty by herself, if she has not had one already; and the sty for this purpose should be roomy, say eight to ten feet square. Short straw should be used for litter, as young pigs are liable to be smothered in long straw. As many young pigs are also crushed by their dam against the wall, it is a very good plan to fix a piece of wood all round the sty, at a height of about eight or ten inches from the ground, and projecting about the same distance from the wall, so that the young ones may be forced under it rather than crushed against the wall.

350. For twenty-four hours after farrowing, the sow should be fed on soft food or slops, which should be given in a warm (not a hot) state. A mash of bran or meal answers very well.

351. A sow giving suck to a good average litter of young pigs requires to be fed generously. For a time

they live on her milk altogether, and if this be deficient they cannot grow big or healthy. Her food ought, if possible, to be given in a cooked state. Should she leave any food in the trough, it is to be removed and given to store pigs. Boiled vegetables, mixed with barley-meal or Indian corn, are very good, and a little bean-meal increases the quantity and improves the quality of the milk.

352. Young pigs are weaned at the age of two months. They should be weaned gradually, and not separated from the dam all at once. At this age they suck her very often. When we begin to wean they should be allowed to suck her six times a day, then four times, three times, twice, and once a day, after which they may be withdrawn altogether. In this way we avoid sudden changes of food, which are injurious to young pigs, and gradually dry up the sow's milk. Buttermilk is very good for newly-weaned pigs; and is much used for the purpose. Boiled roots and cabbages and steamed or boiled potatoes, to which they were accustomed before weaning, may be now given to them. No matter what system of feeding is adopted afterwards, any roots and vegetables given for a fortnight after weaning should be cooked. Immediately after weaning, young pigs must be fed often, say six times a day, the number of feeds being gradually diminished to three, which is the proper number for stores and fattening pigs.

353. Young pigs should also have access for a few hours daily to a paddock or field, as moderate exercise promotes health and vigour; and a plentiful supply of good clean water should be within the reach of both young and old pigs.

354. From the time of weaning till pigs are put on fattening food they are called *stores*. The management of store pigs varies with circumstances. When intended for pork they are kept almost constantly in the sties and yards, so that by gaining condition rapidly rather

than size, they become fit for sale at the age of nine months or thereabouts. Stores intended for bacon usually get more exercise. Many farmers feed them principally out of doors during summer. It happens very frequently that this class of store pigs is sadly neglected. They have to subsist on such offal and refuse materials which they can pick up. In this state they may be called the "natural scavengers of the farm." Pigs eat offal and refuse material which would otherwise perhaps go to waste, and they pay the ordinary farmer best when they consume the refuse of the farm and garden, of the kitchen, dairy, barn, and corn-fields. It is even doubtful if it is profitable to feed ordinary stores on high or expensive feeding. Offal and refuse substances are not, however, always adequate; and when this happens store pigs require other food. In the winter months, say from the end of October to the beginning of May, some roots, cabbages, and small or damaged potatoes may be given to them; and in summer they are kept economically on clover, vetches, and cabbages, which may be given to them in yards, or on grass. To prevent the grass from being injured pigs are ringed.

355. In fattening pigs we ought to be guided chiefly by the principles of animal nutrition already explained. There are, however, points of difference between the food of swine and of ruminants (cattle and sheep). The latter have a set of four stomachs, which enable them to digest straw and hay, and other bulky substances containing a large quantity of woody fibre. The pig, on the other hand, has only one stomach, and requires more concentrated food, that is food containing less fibre.

356. Again, the ratio which the dead weight bears to the live weight, is much higher in pigs than in cattle or sheep; and a fat pig contains a higher percentage of fat than a fat cow or a fat sheep. Thus, while 90 per cent. of the live weight of a fat pig may

be pork, a fat cow rarely gives 70 per cent. of beef from its live weight, and it is considered very good for a sheep to give 70 per cent. of mutton.

357. It is evident, therefore, that fattening pigs require food richer in farinaceous, or starchy, material than cattle or sheep.

358. The economy of cooking the food of fattening swine is, at the present day, universally admitted.

359. Omitting offal and refuse substances, the staple food of fattening pigs, at all events in England, is furnished by the grain crops, Indian corn, and the leguminous seeds.

360. We know farmers who have fattened pigs on ground grain alone, and others who have used Indian meal alone. Many farmers give along with these boiled roots, small and damaged potatoes, bran, pollard, ground barley, and other materials.

361. There are few substances richer in farinaceous matter, or better adapted for pig feeding, than Indian corn; and accordingly, a great quantity of it is now used for this purpose both in America and in the British Islands. It is supposed to be one of the most economical kinds of food we can buy for the purpose. According to experiments, 112 lbs. of Indian meal produces 22 lbs. in the live weight of pigs.

362. Of late years potatoes have become too dear to be given to pigs. Diseased and small potatoes may, however, be used for this purpose. They should be steamed or boiled; and the water which collects in the steaming vat, as well as that in which potatoes are boiled, should never be given to animals of any kind. Potatoes do not fatten pigs rapidly, and the fat of the pork fed on them is said to be rather soft; hence it is usual to give some harder feeding along with them.

363. Fattening pigs are fed three times a day,—in the morning, at noon, and in the evening. They should be fed at the same hours day after day, and get

as much food as they will eat up clean and no more. If at any time a little food is left, it should be given to stores. The troughs should be washed quite clean at regular intervals, for if any food is allowed to remain long in the corners of them it is sure to taint the fresh food. Metal or stone troughs are preferable to wooden ones, as they are more easily cleaned; and the food is not only more likely to stick to the wood, but the wood itself rots and taints the food.

364. The pig is, in the minds of a great many people, associated with dirt and filth; but the truth is, he is, in many respects, cleanly in his habits. For instance, he does not usually foul his litter, but retires to the yard. It is quite certain, that the fattening of swine is eminently promoted by cleanliness. The most careful feeders wash them once a week. If this is considered too troublesome they ought to be rubbed with a good brush or wisp of straw.

365. Fattening pigs, like other fattening animals, eat more at first than afterwards. When they have put on a good deal of fat the appetite becomes less voracious, and better-flavoured food is required. It is for this reason that when pigs are put up to fatten they often get more of bulky and succulent food, and as the fattening advances they get more of the richer and more palatable grains. Pigs are fattened on less food in summer than in winter.

X. POULTRY.

366. The rearing and feeding of poultry form a most interesting and useful branch of industry. Eggs and poultry increase in value with the increase of our national wealth. In addition to the home supply, the imports of this species amounts to about a million-and-a-half sterling per annum. Of eggs, the number imported exceeds one million a day.

367. That the home supply could be increased there can be no doubt. In this chapter we propose to

point out the means by which the tenant farmer and cottager can best aid in promoting this object.

368. We shall begin with a notice of the pure breeds of poultry best suited for ordinary purposes; namely, the Dorking, Spanish, and Brahmas.

369. The *Dorking* is one of the best pure breeds. A bird of this variety is large, has a square well-set body, short whitish legs, and short neck. The flesh is excellent, and the eggs are of good size and flavour. The colour varies, dark grey being preferred. There are five toes to each foot. The average weight of the cock is 8 lbs., and of the hen 6 lbs. The hen makes a good nurse; but she is slow in sitting. It is, therefore, necessary to entrust eggs for early birds to foster-mothers, and for this special duty the game hen is the best.

370. The *Spanish* is a noble-looking bird, of different hues of colour, black being the most fashionable. There is a large red single comb, which in the cock is quite erect, and in the hen turns a little to one side. The breed is further known by a lobe of white flesh behind the ear, and by its white face. The hen lays a large, well-flavoured egg, which tapers at both ends, and weighs from $2\frac{1}{2}$ oz. to $3\frac{1}{4}$ oz., and sometimes more. She belongs to the class of everlasting layers; that is, she continues laying, without indicating any desire to hatch, a property that enhances the value of the breed for producing eggs: hatching can be done by common hens.

371. The *Brahma* is a larger bird than either the Dorking or Spanish, the cock weighing 10 lbs., and the hen about 8 lbs. The flesh is not so delicate as that of the Dorking or Spanish; but when young it is very good, and it is abundant in quantity. The egg is small, weighing not more than 2 oz., and, in common with the eggs of all fowl of Asiatic origin, it has a buff colour. The hens are great layers, and, being hardy, they give eggs in winter, when neither the Dorking nor

Spanish lay. They also make excellent nurses, and by crossing with common fowl give good birds for general use. Being heavy, they are easily confined; and, for the same reason, the roosts require to be within a foot of the ground. The pullets are fully grown at six months, when they begin to lay. For confined places and general usefulness this is one of the best breeds we know. There are two kinds of Brahmas in the country, the white and the dark. We prefer the latter.

372. A poultry house consists of one or more rooms, according to the number of birds kept. Any apartment may be fitted up for the purpose; but if a poultry house is specially built, each room may be six or eight feet long by four feet wide, and not less than twelve feet high, as the air in a low house soon becomes tainted, and bad air is sure to cause delicacy and disease in poultry. Each compartment should have a door about twenty-one inches wide in one corner, and a yard ten feet wide, facing the south. If distinct breeds are kept, the yards require to be covered with wire.

373. As damp is most injurious to poultry, the house and yards should be thoroughly drained. The best floor is a layer of broken stones, over which is placed two inches of clay, well pressed down, and the whole covered with fine sand, or with the fine part of well-sifted ashes. The floor should be carefully cleaned every day, and the manure removed two or three times a week.

374. Thatch is preferable to slates for poultry houses, as it keeps them warm in winter. It is a good plan to line the walls in winter with a thin layer of long, clean wheat straw. This is done by fastening it at top and bottom with nails and listing. All the straw used in poultry houses should be sprinkled with sulphur, to prevent fleas from being generated in it. Roosting-spars, consisting of the one-half of larch

poles, about three or four inches in diameter, divested of the bark, and with the semicircular side upwards, should be placed the entire length of each compartment, and at a height of two feet from the ground for common poultry, and a foot for heavy birds, such as Brahmas. Nests for laying should be placed along the end farthest from the door, and not over each other. There should, if possible, be a separate room for hatching, ; and if the poultry be valuable, and early birds required, it should be heated.

375. A quantity of ashes should be placed within reach of fowls. In this they roll themselves about, by which, it is found, they are kept free from vermin. If ashes be not present, they will scoop out the clay with their toes, which are thereby frequently disfigured. The clay, too, does not destroy vermin as well as ashes.

376. Many persons place broken shells or lime rubbish in poultry yards, under the belief that it supplies material to build up the egg-shell. Poultry take up a little fine gravel to assist the action of the gizzard.

377. Hens and forward pullets, well cared in winter, lay before Christmas, or at latest, in January, and to keep them laying at this season, they require liberal feeding and as much warmth as possible. Corn is the best food for this purpose. Some farmers give all the tail corn to the hens, and it answers very well.

378. For ordinary purposes, it is not desirable to hatch eggs before the opening of mild weather in spring. The general brood is hatched in March, April, and May. A second brood is hatched in July, August, and September, after which hatching is not safe. Very early hatching in January or February is not practised, except for show purposes, or in the neighbourhood of cities or large towns, where early chickens bring 5*s*. apiece and upwards. Early chickens require very careful nursing.

379. A good-sized hen, fully grown, will hatch thirteen eggs; for pullets, eight are quite enough. Those who breed for show purposes, never expect a hen to hatch more than this number. The period of incubation is twenty-one days.

380. Pieces of bread from the kitchen, soaked in water, and dried and grated, is excellent food for young chicks. Refuse stirabout, broken fine, is also good; and after a short time they may get small but clean tail corn. Chopped cabbage or lettuce should also be provided for them. Kitchen refuse, especially dripping, dried and broken fine, is found to be beneficial. Like other animals they are greatly benefited by a mixed diet.

381. For ten days or a fortnight, they should, if possible, be fed once an hour during the day; and afterwards they may have the run of a piece of grass, in which shrubs should be grown for shelter. Wholesome water should also be supplied and renewed every day. They will pick up insects for themselves.

382. The staple food of fowl is grain. Many give the preference to oats, which is recommended to be ground. Tail corn does very well, especially for common fowl. In whatever state it is given, the corn should be scattered thinly on the ground, so as to give the birds exercise in looking for it. They should never get, at a time, more than they will eat clean. A very good way of fattening poultry is to confine them in cages for a few weeks, and to feed them on corn or meal (which is preferred by most people) made into a paste. They are put up at the age of three or three and a half months in summer, and from four to five months in winter. Birds of an improved description and of this age, will fatten in a fortnight; older birds may take an additional week. If confined for a longer time, they go backwards. It has been found that five pounds of barley increase the live weight of poultry by one pound.

383. The fattening of fowl is forced by a process called cramming, which consists in pressing more food into the animals than they would otherwise take. The food is generally made into pellets. Birds fattened in this way are called crammed fowl.

384. As it is found that all animals fatten best in the dark, some persons resort to the barbarous practice of depriving birds of their eyes.

385. Before being killed, fowls should be fasting for twelve hours; and, in order to soften the fibre of the flesh, it is necessary to allow young birds to remain killed for a day or two before using them, and old birds require three or four days.

386. When a fowl is fat, the breast is plump, and fat is easily discovered under the wings; and all over the body flesh and fat are felt on gently pressing it with the finger.

387. If a good description of fowl be kept, the hens will lay, on an average, 120 eggs each, at successive periods during the year; at ninepence a dozen, which is now a low average, this would amount to 7*s.* 6*d.* If fed principally on grain, they will require corn at the rate of half a stone per week for every six birds, with a little chopped vegetables and such kitchen refuse and worms as they can pick up; this gives $4\frac{1}{4}$ stones per annum per bird. Using inferior corn, worth say, about $10\frac{1}{2}$*d.* per stone, the cost per hen is 3*s.* 6*d.*, which leaves a handsome margin to pay for kitchen refuse and attendance.

388. The *Goose* is the most profitable of the large poultry birds. She is not so difficult or expensive to rear as the turkey, and brings nearly as much money. She requires plenty of ground to roam over in search of food.

389. The common geese of the country are capable of being improved by care in selecting the parents, and by crossing with a Toulouse bird, the birds of which are large, well shaped, and of a grey colour.

390. Geese well fed in winter will begin to lay in January, and a good goose lays from fifteen to twenty eggs in the season, and sometimes thirty and upwards. Toulouse geese lay from forty to sixty. In her first season a goose does not lay so many, and her eggs are small. She is in prime laying condition in her third season.

391. A goose that begins to lay early in January, will show a desire to sit in February. She will hatch from ten to twelve eggs, and the period of incubation is thirty days. A turkey hen is often preferred to a goose for hatching; and a common hen is often put on four or five eggs.

392. Goslings receive no food for twelve hours after they appear. Their first food consists of pieces of bread soaked in milk, stirabout, and chopped cabbage. They should have access to a plot of grass and to a limited supply of water at first. A tub sunk in the ground and the water frequently renewed, or a pond, answers better than running water for this purpose; and we have found that ducks and geese fatten rather better on a limited supply of water, renewed sufficiently often, than when they have access to a running stream.

393. A gosling well fed is fit for table in three months. A goose put up to fatten takes from three to five weeks, according to its condition at the time, and the degree of fatness required. It consumes at first 1 lb of corn per day, and $\frac{3}{4}$ of a lb. afterwards. Young geese are benefited by a run on stubble. A large-sized goose gives 1 lb. of feathers in the year, which, instead of being plucked all at once, are removed at two or three separate periods.

394. The *Duck* is prized for its savoury flesh, and gives a large egg, which is not so delicate as that of the hen. It requires little care, thrives everywhere, eats up slugs and insect pests in the garden and in the field, without injury to any crop; hence it is remarkably well suited to cottagers.

395. The two pure breeds most esteemed in these countries are the Aylesbury, which is large in size, and white in colour, and has a flesh-coloured or pale bill; and the Rouen, which differs from the common brown duck, in being much larger.

396. Ducks well fed in winter will begin to lay in January or February.

397. When early ducklings are wanted, the first laid eggs are put under a hen. The period of incubation is thirty days, and the birds should be breaking through the shell at the opening of the first mild weather in spring, before which it is difficult to rear poultry of any kind. In spring, the ducklings are confined in a yard with their nurse for about ten days, and in summer for about three days; while young they are fed on soft sloppy food, with a little meal, and are provided with water in shallow vessels. After this they are allowed to run into water. After three weeks they may be separated from their nurse. When a month old they are found very useful in the garden in destroying the grubs of insects. Ducks are fattened on meal and water; some milk, when available, may be substituted for the water.

398. The *Turkey* is a valuable bird, but while young it is tender and difficult to rear. In addition to the common kind, there are three pure breeds deserving of notice, namely the Norfolk, Cambridge, and American. The Norfolk is the smallest, the hen when fat weighing from 5 lbs. to 6 lbs. The plumage has a rusty jet-black hue. The Cambridge is of various shades of colour, such as black and white, grey and copper-colour, the latter being mostly preferred. The hen when fat weighs 15 lbs., and the cock 25 to 30 lbs. It is fast superseding the Norfolk, which is now reared chiefly for use in small families. The American is the most recently domesticated. It is smaller than the Cambridge. Its flesh is well flavoured, and the brilliant lustre of its plumage gives it a splendid

appearance. When generously fed and skilfully cared, the turkey lays at two and sometimes at three periods in the year; first in spring, second in July, and lastly between Michaelmas and Christmas. The eggs are dropped at intervals of about thirty hours.

399. An average-sized turkey hen will cover thirteen eggs, and the young birds appear after four weeks' incubation. The eggs laid in spring may be hatched as soon as the turkey hen shows a desire to sit, and are found to give stronger birds for breeding than those laid at any other season. They also give full-sized birds for table at Christmas when the demand is greatest.

400. For twenty-four hours after the birds break through the shells they require no food, and should be left to receive the warmth of their nurse. After that they should be encouraged to eat crumbs of bread off the hand. Afterwards they get hard boiled eggs, broken fine and mixed with chopped nettles, lettuce, or cabbage. Sprigs of onion leaves or leeks are particularly good for them.

401. Turkeys are fast-growing birds and dainty feeders. Their food, therefore, requires to be abundant, nutritious, and offered to them very frequently. While they are young it cannot be given too often. Some give it every half-hour during the day, but it is not convenient to give it oftener than once an hour, and even this is troublesome; but any person who is not prepared to bestow time and trouble on young turkeys should never attempt to rear them at all. They require great care and shelter for eight or ten weeks. The most critical time of all is when they begin to throw out the rough scales and plumage that distinguish the sexes. These absorb a large amount of nourishment, and if adequate food be not supplied at this time the system becomes so much reduced that disease is pretty sure to set in and carry off a large number of the birds.

402. Turkeys are fattened on grain and water, or grain and milk if it can be spared, with an occasional supply of green food. Small birds in fair condition will fatten in three or four weeks, but large birds may take twice this time. Turkeys which do not receive adequate food while young, are seldom capable of being fattened with advantage.

PART V.

COTTAGE GARDENING.

403. A COTTAGE GARDEN, properly managed, affords a supply of wholesome nutritious food; and is in many situations capable of being made a source of profit. A garden should, therefore, be attached to every dwelling in the country. Its size should vary with the wants and taste of the family, and with other circumstances. About twenty perches may be made to afford a suitable supply of vegetables for the family of a cottager or small farmer. In this case the main crop of potatoes would be raised elsewhere.

404. In this work we shall confine ourselves to a very simple system of gardening. It is a mistake to propose a complicated style of gardening to the classes for whom we write; and the failure of the attempts hitherto made to extend cottage gardening in this country is owing greatly to the circumstance that the systems described would involve too much labour and expense.

405. How is the plot of twenty perches to be divided? If inclosed with a good fence so much the better. If not, the site should, for the present, be marked out or lined with sods or large stones, and a proper fence afterwards provided as opportunity offers. The walk or walks should be three feet wide. At first it is not absolutely necessary to do more than lay out and level the site of the walk. It would of course be better to complete it at once. The essential qualities

of a good garden walk are, that it should be dry, firm to bear a wheelbarrow, and somewhat elastic under foot. To secure those qualities, it should be drained, the surface soil removed and replaced by a coat of coarse stones or shingle, over which is placed a layer of gravel, and over this again is placed a layer of fine sand. If this should be too expensive for cottagers and small farmers, they can remove a little of the surface-soil and put in its place a layer of broken stones, which can gradually be covered with fine gravel, sand, or coal ashes.

406. Walks are edged with a great variety of substances. The box-plant is very commonly used for the purpose, and, when properly dressed, it looks very nice. This plant grows freely, and is easily propagated by slips or cuttings, or by separating its roots. In the gardens of the gentry ornamental tiles, ornamental castings, and other costly materials are sometimes used as edgings. In a very neat and well-cropped garden, we have seen the walks lined with white stones, placed a foot asunder. Strawberries appear to us to make the best edging in the cottage garden. It is not absolutely necessary to have any edging, but it gives a degree of completeness to the appearance of the garden.

407. We have now to consider the crops to grow in cottage gardens. Assuming that the main crop of *Potatoes* is raised on the farm, in the garden we should merely grow the earlier and more tender sorts, such as a few drills of kidneys, which may be planted in January, and of kemps, planted in February. A few drills of Flanders, which come in after the kidneys and before the kemps, may also be planted. These sorts should be well manured. They can be used in July, and be followed by York cabbage without manure.

408. The *Cabbage* is a most nutritious and wholesome vegetable. It is hardy, and, with a little care, every cottager can have a supply for his table throughout

the year; and any which is not required for this purpose can be given to cows and pigs.

409. In order to have successive supplies of cabbage throughout the year, it is only necessary to make three sowings; namely, first, in the third week of July; second, in the middle of August; and third, in April.

410. Plants from the July sowing are put into the ground in September, October, and November, and are fit for use in spring; those from the August sowing are transplanted in March, April, and May, and are fit for use in summer; and plants of the April sowing are put out in June, July, and August, for winter use.

411. In making the July and August sowings, it is sufficient for cottagers to use Enfield Market, which is the best variety of York cabbage; and in April, the same sort and Savoy should be sown.

412. The *Cauliflower* belongs to the cabbage tribe of plants, and is raised for the flower that grows in the heart of the head. It is a most delicious vegetable. At the table of the cottager it is regarded as a luxury. This crop requires rich ground, plenty of manure, and good treatment. It is planted early in spring, and is fit for use in July.

413. *Broccoli* is very like cauliflower, but is a hardier crop, and stands the winter. The seed is sown in April; and by putting out the plants (transplanting) in succession from the middle of May to the middle of July, supplies of the crop are available for table from Christmas till May.

414. In the neighbourhood of large towns and cities both cauliflower and broccoli pay well. The cottager or small farmer may grow for his own use from a dozen to two dozen plants of each.

415. The *Turnip* is also a useful garden vegetable. Of all varieties of turnips the swede is by far the most nutritious, and is, therefore, the best for the cottager, who should confine his attention chiefly to the production of crops which are capable of affording

nourishment to himself and his family. White stone turnips contain very little nutriment, and are used chiefly with boiled mutton. A drill or two of the orange jelly turnip, a yellow-fleshed variety, may be raised. This variety bears the winter. We often have an abundant supply of it in March when other vegetables are scarce.

416. The *Onion* is used throughout the winter. It requires rich ground and plenty of manure, which is applied in autumn, when the ground should be deeply dug in preparation for this crop. The seed is generally sown in the middle of March, the ground being made into beds of about four and a half feet wide, with alleys about a foot in width. The surface of the beds is broken very fine; drills are opened six to eight inches apart, and about one inch in depth, and the seed sown and covered in with a rake. The *Tripoli* onion is sown in August, transplanted in spring, and used from June till November.

417. The *Parsnip* is an excellent vegetable, and can be sold at a high price in most parts of the country. It is a hardy crop, admitting of being sown as soon as the ground can be got ready for it in spring. In no case should it be sown later than Patrick's Day. If the soil be trenched or dug deeply before winter, and a liberal supply of well-rotted manure applied, every square perch will yield about two cwt. of this crop.

418. The *Carrot* is not so valuable for human use, nor so saleable, as the parsnip, and, consequently, is not so suitable a crop for cottage gardens. Like the parsnip, the carrot requires a deep soil, which, for both, should be trenched or deeply dug before winter. The best soil for the carrot is a deep, rich, sandy loam. On loamy clays the crop is uncertain. The Altringham green-top is the best variety, and it is sown from the middle of March to the middle of April, according to climate and soil.

419. For parsnips and carrots, the ground is, before sowing, marked off into beds, four feet in width, the alleys being one foot wide; the surface is broken fine, and the seeds sown in ruts made with a hoe, and covered in with a rake: for carrots four, and for parsnips three ruts are made in the bed.

420. The *Bean* is an excellent crop for the working man, being both nutritious and easily grown. It is rich in flesh-forming material; but being deficient in heat-giving and fat-forming matters, it should be used with potatoes, which contain an abundance of this constituent, or with bacon, which contains a good deal of fat. *Dwarf prolific* is one of the best sorts for cottage gardens.

421. *Peas* and beans belong to the same natural order of plants. The pea is one of the most favourite crops in the kitchen-gardens of the gentry, who require it for dinner in regular succession throughout summer and autumn; and who, during this period, scarcely use any cabbage. To provide a continuous supply of green peas, it is necessary to make successive sowings from February to the middle of July. In the neighbourhood of large towns, it would pay cottagers to grow peas for market. For home use, a row of a dwarf variety, such as Early Emperor, which grows three feet high, may be sown in February, and a row of a late variety, such as Dickson's Favourite, or Harrison's Glory, which grows four feet high, may be sown in March. If more than one row is required, the lines should be six feet apart, lettuce and spinach being sown in the alleys.

422. Some *Lettuce* should be grown in every garden. It is wholesome food for man, and any not required for human use, can be used with great advantage for pigs and poultry, which are very fond of it. The seed is sown in spring; the plants put into the ground intended for them in May, and the crop is ready for use throughout June, July and August.

For domestic use, a single line of it along any side of the plots would be quite enough. The best variety for cottagers is Victoria cabbage lettuce, which is sown in succession, during March and April, for summer use; and in July, for use in winter and spring.

423. *Spinach* is invariably grown in large gardens. Its use is not well understood by the mass of the people; but as it has very useful properties we would like to see a line, or half a line, of it in the smallest garden. There are two kinds commonly raised, namely, the *prickly*, which is sown in August and September, and used in winter; and the *round*, which is sown at intervals, from April to June, for summer use. Spinach-beet is preferable to the ordinary spinach for cottagers, as it is hardier and less liable to run to seed. The white spinach-beet answers both the purposes of sea-kale and spinach: the foot-stalk of the leaf being used as a substitute for sea-kale in summer, and the leaf itself as a substitute for spinach.

424. *Celery* requires so much manure, that it belongs to the luxuries rather than to the necessaries of the table. If the cottager would wish to grow a line of it, he can do so by sowing in March a few pinches of seed in a well-prepared bed. In the end of May or the beginning of June a trench should be dug to the depth of eighteen inches; in the bottom of this trench a layer of well-rotted dung is placed; over this a layer of clay is placed, and the young plants carefully pricked in six inches apart. As they grow up they require to be earthed, so as to keep the stalks blanched. If this be not done they are unwholesome.

425. We would like to see at least half a dozen plants of *Rhubarb* in every cottage garden. It is easily propagated, either by sowing the seed in spring, or by separating the roots of old plants, the latter

mode being usually practised. The ground requires to be trenched and well manured. The roots are planted three or four feet asunder. *Myatt's Victoria* and *Myatt's Linnæus* are good varieties.

426. *Pot Herbs* are permanent crops; and used for flavouring soups, and for giving a savoury relish to certain dishes. On either side of the entrance walks, or in any corner of the garden, may be planted, in April, a line of thyme, of sage, of marjoram, and of savory. A few tufts of chives would also be useful, and are usually raised from seed or by dividing the roots.

427. Having noticed the more useful vegetables we shall make a few remarks on hardy fruit-trees suited to farmers and cottagers.

428. Of all the fruit the *Apple* is for them the most generally useful. We would suggest the planting of an apple tree in the centre of each plot of the garden. If a greater number of trees is required they should be planted in rows parallel with the walks, the trees being at least six feet asunder, and three feet from the walks. Apple trees should be kept dwarf by pruning, so as not to interfere too much with other crops. The flavour of the fruit of dwarf trees is better than that of large unpruned trees. A good tree will yield a couple of dozen apples the first year, five dozen the year after; in the third year it will give 300 or 400 apples, and in the fourth year it will be capable of bearing the full quantity, which may amount to or exceed 800. At the lowest estimate these would be worth 1*s.* a hundred, and they often bring 2*s.* 6*d.* and 3*s.* wholesale. Twopence a piece have been paid for American apples in the retail shops of our cities and large towns of late.

429. For making pies, *Hawthornden* is a most excellent variety. It is a large, white, juicy apple, and gives a heavy crop. A variety called *Eclean Vale* is another good baking apple, but it is also used at the

table. For eating purposes, we can recommend the following sorts.—*Ribston Pippin* is a dark brown colour, which changes to a speckled yellow as it ripens, and it keeps up to Christmas. *Cox's Orange Pippin* keeps all the year round, and is a great favourite. *Irish Peach* apple is an early kind, and will have been all consumed in August when the pippin becomes fit for use. *Brown Russet* keeps all the year round, and is a very good variety.

430. The *Pear* is not well adapted to cottage gardens, being precarious unless it is well sheltered.

431. Of bush-fruit, the *Gooseberry* is the best. A single bush occupies about one square yard, and, if manured every second or third year, will yield a gallon of fruit (worth 6*d.*), annually for about twenty years, after which it should be renewed. *Yellow Amber* is a good sort for early use; *Red Warrington* is one of the best for general use.

432. Of *Currants*, we prefer the red sorts. A bush occupies the same space as the gooseberry, and gives about 5lbs. of fruit per annum, worth 3*d.* a pound. If the bushes bear freely the ground should get a little manure every year; if not, the manure may be applied every second or third year, as in the case of the gooseberry. *Red Champagne* and *Red Dutch* are two good varieties. The bushes should be kept open in the centre.

433. Of *Raspberries* the yield is at the rate of about 12 lbs. per square perch. With a fair allowance of manure they continue to bear for twenty years. Of red varieties *Antwerp* and *Falstaff* may be recommended to the cottager; and *Magnum Bonum* gives a heavy crop of yellow fruit, which is not, however, fit for preserving.

434. November is the best time for planting apple trees, as well as currant, gooseberry, and raspberry bushes.

435. It will be useful to give a few simple

directions on planting, pruning, and training the fruit trees we have named. The apple tree thrives well on any moderately good soil, which is neither too dry nor too wet; but it lives longest and produces the heaviest crops on rich loams. An excess of iron in the soil or subsoil is injurious to it. The trees are very liable to canker in sandy soils; while on heavy soils, with cold subsoil, they become diseased and covered with moss.

436. Before planting, the ground should be properly prepared; and, when necessary, thoroughly drained. Whether the trees be many or few, it always pays to trench the ground. In wet ground it has been recommended to plant the trees on raised ridges; but as the roots would eventually go down to the moisture it is better to remove it by drainage. If the soil is not very rich, it should be well manured at the time of trenching. The manure should be well rotted, or, what is better, formed into a compost with turfy or fibrous loam. The compost should be worked in as the trenching proceeds, and covered to the depth of a foot or more. Before commencing to plant, the proper distance between the trees will have to be determined. Wall trees and espaliers should be planted twenty feet apart; for dwarf standards trained in the pyramidal form, ten feet is enough; full standards will require twenty-five or thirty feet between the rows, and the same distance between the trees.

437. The best season for planting is the beginning of November, or as soon as the greater portion of the leaves has dropped off. When circumstances do not admit of planting so early, it can be done with safety, in mild weather, at any time before the sap commences to circulate, which in forward trees generally happens in February. The work cannot be safely performed afterwards.

438. The spots where the trees are to be planted ought to be marked; the holes made large enough to

enable the roots to be stretched to their full length; and the compost applied at the rate of one or two barrowfuls for each tree according to the soil. The tree is then planted to the same depth as it was before removal. The hole should be deeper at the sides than in the middle, so as to allow the roots to slope gently downwards from the stem to the extremity. The tree should be taken up with all its roots uninjured; and any roots that are unavoidably broken should be cut off. In planting, the roots should be spread out evenly over the bottom of the opening. When the roots are properly placed, fine soil should be put over them, taking care to scatter it in the direction of the fibres or small roots, as they might be reversed and injured when the soil is thrown carelessly against them, as is frequently done. When the hole is about half filled give a gentle treading to the soil about the roots; then finish the filling, and support the tree with a few stakes. The roots should be protected by "mulching" the ground over with litter as far as the roots extend.

439. In planting against walls, the hole should gradually incline downwards so as to give the roots the same dip into the soil as before. The tree should be planted nine inches from the wall, to give the stem room to thicken without danger of pressure against the wall. Much of the success of fruit trees depends on the way they are planted. If the simple suggestions above given are strictly followed, satisfactory results will be obtained.

440. The rules laid down for planting the apple are equally applicable to all kinds of hardy fru trees.

441. There are many different methods of training The open dwarf, or as it is commonly called, the "punch bowl" method is well adapted to the production of a large crop of fruit, and is especially suitable where the space is limited. Apples, cherries,

and plums do remarkably well when trained in this way. Pears do better when trained in the pyramidal shape. In order to bring a tree to the desired form as an open dwarf, the following points must be attended to:—A tree planted out of a nursery in November should be cut down to within nine inches of the ground the following autumn. The tree will afterwards produce vigorous shoots, three of which should be selected and encouraged to make vigorous growth during the summer; this can be done by pinching out the tops of the most forward shoots. These shoots must be cut back the following winter to within nine inches of the stem. During summer of the succeeding year six shoots are allowed to grow freely. These six branches should now be tied to a hoop six feet in circumference, the branches being secured at equal distances. When the branches are tied to the hoop they should be shortened to within a few inches beyond it. The desired form being obtained, the after-pruning consists of spurring, or cutting in the annual summer's growth to one or two eyes or buds, and shortening the leader or young annual shoot on each branch to six eyes. Care should be taken to keep the centre of all fruit trees open to the sun and air. The branches should never cross or even touch each other.

442. In training dwarf pyramids, allow the tree to establish itself for a year, then cut it down to within eighteen inches of the ground. Train a shoot from the uppermost bud upright, and all below this one should turn outwards. In the following winter, the leader is again to be cut back to within eighteen inches of where it was cut the previous year. Proceed in this way until the tree attains the desired height, which should never be greater than ten or twelve feet. The side shoots should be trained in regular tiers one above the other, and lessening in circumference as they get higher.

443. The Espalier mode of training is well adapted for either large or small gardens. Of all modes of training it occupies the least space, and the ground between the rows can be cropped to within a foot of the trees. When the tree has been a year established it should be cut down to within eighteen inches of the ground. In summer train the leading shoot upright, and one to the right and another to the left horizontally. The following winter cut back the leader to within a foot of where it was previously cut, and train two additional shoots to the right and left as before; and continue the same system of pruning year after year until the tree has filled the space allotted to it. The horizontal branches are cut back every year, leaving only six buds. This mode of pruning applies to wall trees as well as espaliers.

444. The *Strawberry* is the best small fruit for the cottager. It is easily propagated, grows freely, and gives an abundant crop of delicious fruit. In June and July the plants produce runners, and, at certain points, each runner throws out a number of bunches of roots, which soon become independent of the main stem, and may be cut off and put out as separate plants. A fresh plantation, made in this way, will bear fruit the subsequent year. It requires to be renewed every third year, as the old plants *wear out after three seasons.*

445. Strawberries are planted in rows eighteen inches apart, the plants being placed the same distance asunder in the rows. The ground is hoed in autumn, and farm-yard manure pointed in before winter. A square perch of strawberries treated in this way will yield about 16 lbs. of fruit annually for three years. The price is not less than 4*d.* per lb., and it is often a great deal more.

446. There are a great many varieties of this favourite fruit. *Trollope's Victoria* and *Myatt's Eliza*

are the best for general use. *Keen's Seedling* is, in the opinion of Sir Joseph Paxton, the best for cottagers. *Sir Harry* is an excellent strawberry, and of late kinds *British Queen* is one of the best.

447. The crops in the garden, as in the field, should succeed in regular rotation, and in accordance with certain scientific principles. It is impossible to lay down rules applicable to all cases. The same crop should not be repeated in the same ground, nor should plants of the same family succeed each other. Strawberries should never follow strawberries, nor should peas succeed beans.

448. Potatoes may be followed by cabbage; onions by parsnips and carrots; or onions, parsnips, and carrots may come, in the same division, after cabbage. Potatoes may follow cabbage with advantage. As soon as the cabbage is removed in autumn and winter, the ground should be dug deeply and left exposed till spring; and as the cabbage is always heavily manured, only a small quantity of manure will be required for the potatoes. Again, if celery is grown, it requires to be heavily manured, and may be followed by onions. which require rich soil.

449. Deep-rooted plants, such as parsnips, should be followed by plants which grow chiefly in the surface soil. A summer crop like peas is followed by broccoli or winter cabbage, and so on.

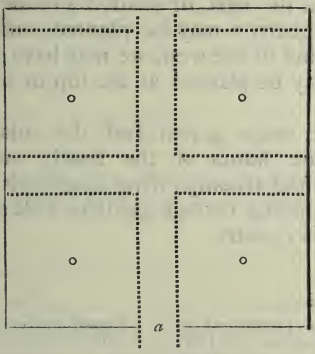
450. It may be useful to give one or two sketches illustrating simple plans of laying out cottage gardens.

In No. 1 the entrance is at *a*; the small o's in the centres of the plots represent apple trees. The walks are lined with strawberries; the dotted line at the top of the garden is intended for bush fruit trees, such as gooseberries and currants.

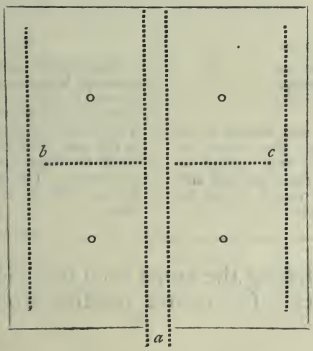
451. The walks may be lined with strawberries, except one line on the east, or most shaded part of the walk, to be reserved for parsley, which should be

sown in March, in a rut, made one inch in depth, and three inches from the walk.

No. 1.



No. 2.



452. In fig. 2 the entrance is at *a*, as before; there is only one walk running straight through the garden,

and it is edged with strawberries; a row of red currant bushes, *b c*, is planted across the middle of the garden, dividing it into four squares; in the centre of each square an apple tree is planted; in the dotted line in the east, or shaded side of the garden, a row of raspberries may be planted, and in the corresponding line to the west, we may have gooseberries. Pot herbs may be planted at the top or bottom of the garden.

453. The crops grown and the rotation should vary with the wants of the family and with the markets. In the accompanying diagram is explained a system of cropping cottage gardens well suited to the people of this country.

No. 1. Kemp potatoes, planted in February; the ground cleared in July, and planted with Savoy cabbage of the April sowing. This cabbage will be fit for use in November; so that two crops are obtained in the year.	No. 2. Enfield-Market cabbage, planted in February, which will be fit for use in June, and may be succeeded by Swede and Orange Jelly turnips, giving two crops within the twelve months.
No. 3. Carrots. Parsnips. Onions. The parsnips and onions to be sown in March; the carrots in April. A second crop cannot be obtained within the year after any of these. The ground should be ridged up in winter.	No. 4. Peas, beans, and white turnips, sown in March; removed off the ground in July, and succeeded by lettuce, cauliflower, and celery. The lettuce seed should be sown in the last week of May, so as to be fit for transplanting after peas and beans. The celery and cauliflower seed should be sown in May.

454. By shifting the crops from one plot to another for four years, a four-course rotation would be established.

PART V.

ON THE MANAGEMENT OF THE SEVERAL CLASSES OF HOLDINGS IN IRELAND.

I. ON SOME OF THE DEFECTS IN IRISH AGRICULTURE.

455. The surface of Ireland contains upwards of twenty millions of acres; one-half of it is in permanent grass, one-fourth is under tillage, and the remaining fourth is under water and waste.

456. The area under grass is far greater than in any country in Europe similarly circumstanced. The rich fattening lands and all the high hills should be left in pasture; but it has been estimated that there are four millions of acres of medium land now growing poor grass which would pay far better in tillage. At present the gross return from these four millions of acres does not exceed twice the rent of, say, £1 an acre; if put under a proper system, the yield would amount to five times the rent, and the wealth of the country could be increased to the extent of £3 an acre, or £12,000,000 a year, which would be available for distribution among labourers, farmers, manure and seed merchants, and shopkeepers of all kinds. In due time, too, the landlords would obtain an increase of rent; for it is a law of agricultural progress, that anything which increases the farmers' profits, tends to advance the rent of land.

457. The average yield of the six millions of acres of grass land that would remain, could, by the application of correct knowledge, be increased very considerably.

458. The present state of our grass lands arises from—1st, want of skill and care in the cultivation of the land; 2nd, ignorance on the part of the farmer of the proper grasses to grow on given soils; 3rd, want of care and skill in sowing them; and 4th, want of care and attention in weeding the grass land, as well as want of skill in top-dressing it. There is not, perhaps, in Irish small farm management a greater defect than the mode of producing grass. Sometimes the farmer does not sow any grass seeds at all, but allows the land to cover itself with whatever herbage it throws up naturally. Again, thousands of small farmers put their land into grass when it is reduced by corn crops and bad management to such a state of poverty that it will no longer give even a middling crop of grain. Now, of all farm crops, the grasses luxuriate most in rich land. And, accordingly, good farmers never put land into pasture, unless it is in good condition.

459. The state of the cultivated land of Ireland is also very defective, as is well known to all persons of experience. Throughout the country we meet a great many farmers who till their land in a very creditable way; but it is notorious that on the vast majority of small farms the mode of management is very bad—the tillage shallow and imperfect.

460. As a rule, Irish small farmers do not follow any systematic course of cropping, or observe any of the principles which modern science suggests. When a proper system of cropping is adopted on tillage land, all parts of the farm are manured in a certain number of years. Under such a system it is all equally enriched; and if the land be well tilled and kept clean, all the crops are heavy and profitable.

461. Manured root crops form the backbone of the rotation of crops. A great many of the small farmers of Ireland do not grow any manured crops but potatoes. They ought to grow turnips or mangold, or some of both, for feeding their cows in winter and spring. The value of these crops is more fully considered in another section; here it is enough to say that their absence is a great defect in Irish agriculture.

462. In many parts of the country little or no artificial grass is grown; and the want of this is, perhaps, the greatest defect in the management of our small farms. On thousands of these farms there is no hay for wintering the cows; the result is that the animals are dry during winter and spring; and at the opening of the dairy season in May they come out in a half-starved state.

463. Tillage is done in a slovenly fashion. Root crops are, as stated above, the basis of improved agriculture; a condition essential to the growth of these crops is to dig or plough the land deeply as early in autumn as possible, so that by the action of the weather during winter, plant food would be liberated, and both weeds and the eggs of insects destroyed. The ground should also be well prepared for the corn crops at a sufficiently early period. By good, early, and deep tillage, the value of every acre of arable land in Ireland could be increased by at least £1; so that by this means alone the wealth of Ireland would be increased by upwards of five millions sterling, even without adding to the area of cultivated land.

464. Sufficient care is not taken to keep the land clean. In some parts of the country weeds are permitted to grow freely, and to shed their seed; this causes a heavy loss. The yield of the crop is greatly reduced, as the weeds take up the plant food, which would go to feed the crop if the land were kept clean. When weeds are allowed to seed they do the greatest

mischief; for it is known, that in seeding, plants are severest on the ground. Each seed formed is, moreover, capable of producing a full-grown weed afterwards. It is no uncommon thing to find ten tons of weeds in an acre of potato ground.

465. The collection and preservation of farm-yard manure do not receive the attention they deserve. The manure made in the bawns of thousands of the small farmers of Ireland is not, in reality, farm-yard manure at all, but compost. A quantity of clay is carted from the headlands or old ditches, and thrown into yards or pits in front of the dwellings; and on this is poured daily kitchen refuse, giving rise to effluvia which poisons the air that enters the dwelling. Again, in thousands of cases, manure is left to rot in loose heaps, by which a good deal of its substance passes into the air; and, in an equally large number of instances, the rain water is permitted to drain away its substance into the nearest rivulets. It is not quite easy to estimate the loss annually incurred in this way by Irish farmers, but we may go near the truth. There are grown every year about 1,500,000 acres of potatoes and root crops; each acre of these gets, one with another, at least ten tons of farm-yard manure, and each ton of this is not within sixpence of the value it would be if properly made. This gives a gross loss of £375,000 a year; but the loss to the farmer is, in reality, far greater, for deficiency in tillage or manure may reduce the crop one-half. The deficiency of crops in Ireland, arising from bad manures, amounts to several millions sterling per annum.

466. In the treatment of all our farm crops, we see bad management everywhere. As already stated, the tillage is imperfect. It is often done too late; the crops are not sown in time; the proper varieties of crops are not used; all the crops are often allowed to become over-ripe, by which a large quantity of corn is shed, and the land seriously injured. As an illus-

tration of this mismanagement we may take the hay crop. First, it is exposed too much to rain, which, as already explained, washes away a large quantity of its nutritive matters. 2nd—It is often exposed too much to the sun, which also lessens its value very considerably. 3rd—By too much exposure, or by fermentation, it suffers loss of fragrance and of colouring matter. We know by experience that there is an enormous difference in the feeding value of hay, according to its colour and fragrance. 4th—The hay is commonly allowed to remain so long in cocks in the fields, that the surface of these cocks becomes drenched by rain and bleached by the sun; and the part in the bottom not only becomes unfit for use, but causes a loss of aftergrass. Putting these several sources of loss together, it was estimated some time ago that, on an average, the hay crop of Ireland is deteriorated to the extent of one-fifth of its value.[1] We meadow annually about 1,500,000 acres; the average yield is two tons per acre; the total produce is, therefore, 3,000,000 tons, which, at £2 10*s.* per ton, amounts to £7,500,000; and one-fifth of this, or £1,500,000, is lost.

467. The *Live Stock* of Ireland is not made as profitable as it ought to be. The quality of the animals has increased greatly of late; but there is still great room for further improvement, especially in the stock kept by small farmers. The gross value of the horses, cattle, sheep, and pigs in Ireland is considerably upwards of forty millions. By better modes of rearing and feeding, this could be increased by one-fifth in five years; and, as the quality of the animals on the small holdings is the lowest, the greater part of this addition to the wealth of the country would go into the pockets of the small farmers. Evidence of the enormous loss suffered in this way by our small

[1] See the Author's *Prize Essay on Haymaking*.

farmers is afforded in the fairs held throughout the country.

468. Dairy business is badly managed in many parts of Ireland. In butter making alone, there is room for improvement to the extent of £1 per cwt., or £1,000,000 a year.[1]

469. We slaughter annually in Ireland about half a million of beasts, and export to Great Britain about a third of a million. A large number of them are sent to market in very good condition by the graziers, large farmers, and landed gentry of Ireland. It is well known, however, to those who attend the Irish fairs and markets, or witness the shipment of cattle from Irish ports, that a great many beasts are sold, either in a half-finished state, or sent to England as stores. The loss on the former is very considerable; for, as observed in another section, beasts pay better for their keep in the more advanced than in the early stage of fattening. And again, as our climate is on the whole better adapted for roots than that of England, we see no reason why a large number of the store cattle now exported should not be fattened in Ireland. It would increase the profit of the farmer and the wealth of the country; the large quantity of valuable manure obtained would put the land in better condition for other crops, and the labouring class would receive more employment.

470. The want of proper drainage is another serious defect in Irish agriculture. An excess of water in the soil is most injurious; it renders the ground cold and the harvest late, and produces effluvia which are injurious to man and animals.

471. It may be stated as a rule, that all peaty and clay soils are improved by thorough drainage. All grass lands that contain rushes, sedges, and other water plants are also in want of this improvement.

[1] See sections on Dairy Management.

We may feel certain, too, that grass lands which have here and there patches of a brownish or unhealthy green through them, contain too much water. We have in Ireland at least 6,000,000 acres of land in need of drainage. This work could be effected at a cost of £5 an acre, which would give a rentcharge of 5*s.* an acre; but the increased value of the land, consequent on drainage, would be at least 10*s.* an acre, and on hundred of thousands of acres of bog and clay it would, after a few years, be fully £1 an acre. Taking the average at 10*s.* the annual letting value of the land of the country would be increased by £3,000,000 a year.

472. Many persons will ask, Where is all the capital to execute this work to come from? We answer that the bulk of it is in the labour of the people. The farming classes of Ireland have a great deal of labour in their families which could be most usefully employed in draining their land.

473. The state of the fences is not satisfactory in any part of Ireland. In the grazing districts of Leinster the dykes and ditches, being often imperfect, cause great waste of rich land. On the Glasnevin Model Farm, which contains about 180 statute acres, thirteen acres of fence have been levelled. Again, in many parts of the country the fences are inadequate for preventing trespass.

474. It is desirable that a farm should be divided into square or rectangular fields, which cause little waste of the time of horses and men in cultivating them. These fields should be surrounded with whitethorn hedges, which occupy little ground.

475. Fences are useful in affording shelter; and they are necessary in enabling the farmer to use his grass land to the best advantage. But the levelling of existing fences, and the erection of straight ones in their place, should not be undertaken without due consideration. Indeed, this improvement, though

useful and desirable, is not the one which should be first made in the most neglected of our small farmer districts.

476. There are several other defects in Irish farming; but those which we have mentioned in this chapter will serve to show young farmers what a mine of wealth lies unworked in the soil, and how, by the application of *industry* and *skill*, their own wealth, and, consequently, the wealth of the country, could be vastly increased.

II. ON CLIMATE AND OTHER MATTERS AFFECTING IRISH AGRICULTURE.

477. That climate influences the agriculture of a country or district is well known to all intelligent persons. A good illustration is afforded by English agriculture. A range of mountains running from north to south divide England into two agricultual sections; a greater proportion of corn is raised in the eastern, which is the warmer and drier section, while in the western, which is the colder and more moist, there is a larger proportion of permanent pasture. Ireland has a climate which approaches more to that of the western than the eastern section of England. As compared with the corn-growing districts of England there are two defects in the Irish climate, namely, a low summer temperature and a high degree of humidity. Both these defects are overcome to a certain extent by drainage. The thorough drainage of the whole of Ireland could not, however, make the climate equal to that of the east and south-east of England for the growth of grain. This proposition admits of no controversy. It is true as any law of Nature. Some persons, who take a superficial view of this principle, carry it so far as to say that the climate renders

Ireland wholly unsuited for tillage farming—a proposition which cannot be maintained.

478. The climatic phenomena which mainly influence the agriculture of a country or district are the rainfall and temperature.

479. The fullest record of the rainfall in the United Kingdom is given in Mr. Symon's annual publication, according to which the average rainfall of England, Scotland and Ireland, for a period of sixteen years, is represented by the following figures :—

England	. . .	33·77 inches[1]
Scotland	. . .	34·02 „
Ireland	. . .	31·98 „

480. As these figures are too general, we shall compare the rainfall in a few well-known stations in England and Ireland. It is impossible to select places similarly circumstanced as regards the local causes that influence the rainfall; but the following table will explain the matter sufficiently :—

AVERAGE RAINFALL.

England.	Inches.	Ireland.	Inches.
1. *Exeter*, in a southern county and westward	31·1	1. *Cork*, in a southern county and westward	34·4
2. *Norwich*, in an eastern county	26·7	2. *Dublin*, in an eastern county	29·1
3. *Oxford*, in a midland county	25·7	3. *Tullamore*, in a midland county	25·7
4. *Nottingham*, in a midland county and northward	26·5	4. *Armagh*, in a midland county and northward	29·8

481. A glance at the map of the British Islands will show that these stations have not been selected so as to make out a case for the Irish climate. The advantage is rather the other way. Yet the table does not go to support the opinion of those who maintain that the climate of Ireland is too wet for tillage farming.

[1] Symon's *British Rainfall for* 1872, p. 137.

An ardent supporter of this theory has recently contributed a paper to one of the leading agricultural journals, in which he seeks to show that owing to the humidity of the climate of Ireland, the area under grass ought to be increased. His style of reasoning is peculiar, to say the least of it. He gives elaborate tables of the rainfall at Valencia, County Kerry, for five years; and finding it to be 53 inches, he would lead us to conclude that our climate is too wet for arable farming!

482. It would be quite as logical for him to maintain that because the average rainfall at Seawaite, in Cumberland, for the same five years was 151 inches, tillage ought to be abandoned in England.

483. In order to afford a full exposition of the influence of the rainfall on agriculture, it would be necessary to give the quantity of it which falls in the several months, as well as the number of days on which it falls. The size of this treatise precludes us from entering upon an exposition of the kind. Our object is to afford sufficient evidence of the fact that the rainfall in Ireland does not offer any insuperable obstacle to the success of a system of mixed husbandry, such as we expound.

484. The same may be said of the temperature, the average of which throughout the year is rather higher in Ireland than in England. At Dublin, for example, the average is higher than at Norwich, and at Cork it is higher than at Exeter. In the summer months the temperature is higher in England than in Ireland, and this gives the English farmer an advantage in the growth of wheat and barley; but in the winter months the temperature in Ireland is higher than in England, and this gives the Irish farmer an advantage in the fattening animals, as well as in the feeding of milch cows and store stock.

485. Tillage, as practised in the best farmed districts of England and Scotland, consists in the growth of roots, of grain, and of artificial grasses, in a certain order which

we call the succession or rotation of crops. Now, it is notorious that Ireland is better adapted for the growth of turnips than England. The mangold crop does better in the east and south-east of England than in Ireland; but, on the whole, a considerable portion of Ireland is favourable to this crop, as regards soil and climate.

486. Again, the soil and climate of Ireland are proverbially favourable to the growth of grasses; and quite as much so to the growth of the grasses of tillage as of the grasses of permanent pasture. The chief grasses of tillage farming are red clovers and rye grasses. In Ireland heavy crops of red clover are raised; and far weightier crops of Italian rye-grass are obtained in Ireland than in England. Nay, more, the heaviest crops of this valuable grass are produced in the wettest parts of Ireland.

487. To complete the succession of crops we require grain. It will be remembered that the order of succession in the common four course rotation is :—

1st year—Roots.

2nd year—Grain with seeds.

In England barley is usually selected for this place in the rotation. In many parts of Ireland and of the south of Scotland barley can be successfully grown.

In the remaining parts of the arable land of Ireland oats can be sown.

3rd year—Artificial grass, of which, on the whole, a heavier return is capable of being obtained in Ireland than in England.

4th year—Grain.

In the drier parts of England wheat succeeds artificial grass, which, as already observed, is generally red clover. In Scotland and Ireland oats takes this place in the rotation.

488. On most well-managed farms of good land lea oats pays in Ireland. When the ground is dry or poor, lea oats is, however, a precarious crop. But lea oats or lea corn of any kind is not an essential part of

tillage farming. In other words, we can pursue a judicious system of tillage without it. In several places we have, in our own practice, abandoned lea oats altogether, and substituted what we call convertible husbandry for alternate husbandry, or for the ordinary rotation of crops.

489. What is convertible husbandry? It is the alternation of grass and tillage. A field or fields of grass are broken up according as they show signs of poverty, and cropped with roots and potatoes for one or two years, according to circumstances; after which barley or oats is grown, and the land laid down with suitable grasses. The land is meadowed or grazed the year after, and continued in grass until it again shows signs of poverty.

490. In pursuing this system, all the principles of improved agriculture can be observed, and the land maintained in a productive state.

491. To persons accustomed to raise roots after lea oats, the preparation of grass land for turnips or mangolds may appear an objection to this system; but the simple mode of management described in paragraph 546 meets this objection.

492. It follows from the foregoing facts that Nature does not put any insurmountable difficulty in the way of carrying out a suitable system of tillage farming in Ireland.

493. Among the obstacles to the extension of tillage farming at present, a prominent place must be assigned to the change that has taken place in the labour market. The tide of emigration from Ireland having greatly reduced the supply of Irish labour, and the growth of manufacturing industry in Great Britain having increased the demand for labour at home, the wages of labour have risen very considerably. The employers complain that the men do not give anything like an equivalent return for the increased wages. The labour maket will in due time settle down into a healthy state;

and we may hope that employers will, at no distant day, derive at least as large a return from every shilling expended on labour as before. It is even possible that the rise of wages may excite the inventive power of man so far that, by the introduction of improved mechanical appliances, the cost of producing crops would ultimately be very sensibly reduced.

III. SUGGESTIONS FOR THE BETTER MANAGEMENT OF SMALL FARMS.

494. Small farms may be divided into several classes. First of all, there is a vast number of cottier holdings, not one of which is capable of giving continuous employment throughout the year to an able-bodied man, and which should not, in strictness, be called farms at all. The occupiers of these little holdings are neither farmers nor labourers, but occupy a sort of intermediate place. In times of distress they suffer great privations. As farming improves and society progresses; as the wages of farm-labourers rise, and their houses become more comfortable, a number of this class will elect to live by hired labour. In some parts of the country they still form, however, a numerous class. Each holding consists of a few acres of arable land, which, in many cases, has been reclaimed from a state of nature. Potatoes are raised for home use; a patch of oats is also grown, the produce being either ground into meal, or sold to buy other necessaries; and the remainder is in pasture, generally of the worst description, for grazing a cow. The sales consist of some oats, eggs, and poultry, and a pig or two, and occasionally of a little butter, which, owing to the way it is made up, rarely brings more than two-thirds the price of first-class butter. To these poor people the pig is a valuable savings-bank; and out of his price the rent is almost invariably paid.

Whenever any violent contagious disease, such as the hog-cholera, attacks the pigs of a district, cottier-farmers suffer heavy losses, and require time to pay their rents. The possession of a cow is a great boon to persons of this class, her milk being nutritious and wholesome.

495. Any holding large enough to give continuous employment to an able-bodied man all the year round may be called a farm. Small farms would begin at this standard, and end with a class on each of which one horse must be kept, but which is not large enough to employ a pair of horses all through the year.

496. In improving the condition of both cottier-holders and small farmers, a few leading ideas are applicable. In the present management of the vast majority of them, we find the same absence of any correct mode of cropping; the same injudicious system of raising grain after grain; and the same want of roots and of artificial grass. By the application of more skill, they could live much better than they do. The prevailing system is to sow oats after potatoes, and to repeat the oat crop until the land gives little more than the seed. The ground is then put under potatoes again, and the same round of oat crops repeated; or the land, when unable to bear corn, is put under permanent grass. In very many cases no grass seeds are sown, the land being left to cover itself naturally. As a rule, no root crop is raised, nor is there any artificial grass for meadow. A cow, when kept, is half starved in winter, having nothing but the run of the pasture, and a little straw in severe weather.

497. In place of this, we would suggest, as a beginning, that the grain crop after the potatoes should be laid down with artificial grass. In the following year, at least two cuttings of grass will be obtained off this part of the farm. The ground under oats this year

should be cropped next year with potatoes and turnips, or mangolds, or some of each, according to circumstances. The potatoes will probably require all the farm-yard manure available; the turnips and mangolds may be raised with the aid of artificial manure. The poorest part of the oat ground should be reserved for the crop or crops to which farm-yard manure is to be applied.

498. The small farmer need not raise at first more than half a rood of roots for every cow he keeps. He will soon learn to appreciate the value of these crops, not only for cows, but for his pigs.

499. If, from any cause, the small farmer is compelled to sow grain after grain on part of the farm, care should be taken to select for this purpose the best of the stubble, and to top-dress it with artificial manure.

500. It is very likely nothing will be done to improve the pasture-land the first year. A great deal of this kind of pasture is on shallow or rocky soil, which would not admit of tillage. In the ensuing autumn or spring it should be top-dressed with a good compost of clay and lime. For this purpose clay can be taken from old ditches or from headlands. If lime cannot be had conveniently, a good grass manure, at the rate of 2 cwt. per acre, may be mixed with the clay. If an abundant supply of clay can be had, some permanent grass seeds may be sown and harrowed in at the approach of mild weather in spring. Land now bearing bad grass, and which is deep enough for tillage, should be broken up piece by piece, as the means of the farmer will admit, put through a course of tillage, and, if desirable, re-laid down with suitable permanent grasses. By pursuing the system thus briefly sketched, the small farmer can raise as much potatoes as before, and fully as much oats; and, by the use of roots and hay, and hand-feeding, he can have milk from his cow during the winter, and also be able to keep, during

winter, a heifer and an extra pig or two. It is useless to expect these small farmers to establish a rotation of crops on their holdings at once; they could not do it for want of capital. But, by pursuing the course pointed out, the main principle of the rotation of crops is put into practice at once, and the small farmer is not asked to do anything beyond his reach.

501. It is necessary to make a few remarks on the extra capital required to carry out this system. It has been often remarked that small farmers have no capital to adopt any new or improved system of management. This objection is invariably made by writers and others who have no practical experience. The author has, in numerous instances, seen the system he describes followed by small farmers of very slender means. There is no small farmer of good character who cannot get reasonable time to pay for the seeds and artificial manures required to begin with. When the root crops become fit for use, it may be necessary to buy a cow to consume them. Where is the money to come from? We answer, and say, that a great many small farmers, even of those who do not farm in a skilful manner, have, by great frugality and thrift, saved a little money, which is often either lying idle, or is in banks at a very low rate of interest. If laid out in the way suggested above, it would pay a high profit; in some cases as high as a pound for every pound invested. On the other hand, there is a vast number of small farmers who have not saved money. Some of them may, however, be able to borrow the whole or part of the price of the cow. When this could not be done, we have more than once induced the farmer to sell part of the roots the first year, and with the money so obtained to buy a heifer, which will grow and increase in value: and with the money realized by her sale, a milch cow can be purchased afterwards.

502. It will be seen that at first we do not urge

on small farmers to pursue any rotation of crops, experience having taught us that many of the essays and treatises hitherto written on the subject have failed, because they required too much. A notable instance of this has come under the author's notice, in a district in which several of the landed gentry were interested in trying a system of small farm management suggested in a prize essay. The system advocated in the essay referred to is so complicated, that it has not been followed by a single farmer, not even by its author. The rotation suggested would extend over twelve years; the farmers most in need of advice would forget all about the beginning of it before they should come to the end. To be successful, any system proposed for improving the agricultural practices of small farmers must be simple. From the outset, however, every change made should be sound, so far as it goes; and it should tend, as far as practicable, towards the course which would ultimately be permanently established as the best on any given farm. How are we to determine this course?

503. It is not possible to explain what is best to be done in every case that will occur; all we can do in this treatise is to give a few general directions, and to illustrate them afterwards by examples. As a rule, it may be stated, that a spade-labour farm should be all under tillage, except a paddock in which the stock could get exercise. The cows should be fed in the house throughout the year: in summer, with grass and a little hay or straw; in winter they should get roots and fodder, the quantity of roots varying with the quantity of milk the animals give. Cows in full milk get about eight stones of roots per day, with fodder; dry cows should be fed on straw and hay; and as the yield of milk decreases, so should the supply of roots, until they are withdrawn altogether; because it does not pay to give roots to dry cows, or to give them in large quantity to cows yielding only a small quantity

of milk. An occasional feed of roots is, however, useful to cows in calf, as it helps to keep their system in a healthy state.

504. The house-feeding of milch cows all the year round is one of the best means of improving the condition of our small farmers. It has been one of the mainstays of the small farmers of Belgium. A house-fed cow, of average size and of fair quality, will give from 500 to 600 gallons of milk in the year, or, say 550 gallons. If the dairy were managed skilfully, the milk would realize, on an average, $7\frac{1}{2}d.$ per gallon, or £17 per cow. A cow of the same description, under the prevailing mode of treatment, does not give over 300 gallons of milk. The house-feeding of cows all through the year involves a good deal of labour; and when, as on large farms, the whole of the labour has to be paid for, house-feeding in summer does not pay. And as we advance from spade-labour farms to the larger class of small farms, it may be stated that, generally speaking, a modified system of grazing and house-feeding, in summer, answers better than feeding altogether in the house.

505. The four-course rotation, or a modification to be explained further on, may be pursued by small farmers of this class. From six to eight acres of arable land put under this rotation is as much as an ordinary family can cultivate with the spade. What they cannot till sufficiently may be put into pasture for the cows and young stock. The areas to be kept in tillage and grass, respectively, depend on a variety of circumstances, such as the nature of the soil, the extent of the holding, and the quantity of labour available in the family.

506. According to the classification we have adopted, a cottier farm is intermediate in size between a cottage garden and a small farm, and is not large enough to give continuous employment throughout the year to an able-bodied man.

507. As every cottager who has a piece of land should if possible, keep one cow, the question at once arises, what is the smallest area on which she can be maintained all the year round? As this question possesses the deepest interest for a large number of the people of this country, we shall answer it pretty fully. In the first place, it may be remarked that a cow can be house-fed all through the year on purchased feeding. A gentleman of our acquaintance feeds a small cow in his stable all the year round. Her daily allowance of food consists of two and a half pounds of cotton-cake, one pound linseed-cake, and four pounds bran, with hay and water. The cake and bran are prepared in the way to be afterwards described, and divided into three feeds. The animal gets exercise for ten minutes every morning in a lane at the back of the house, and is well groomed with currycomb and brush. Last year her milk averaged eight quarts a day, and supplied the wants of a family of fifteen, including servants. The cost of the cake and bran averaged 7*d.* a day.

508. Let us now take the case of a cottager in a remote district who wants to feed his cow principally on crops raised on his holding. We find that on two acres of ordinary arable land put under the four-course rotation, a cow can be kept. The two-acre farm would be cropped as follows :—

1st—Two roods of roots.

2nd—Two roods of grain laid down with grass-seeds.

3rd—Two roods of grass, the greater part of which should be cut with the scythe, and given to the cow in the house, and the remainder made into hay for winter use.

4th—After the grass we may plant the main crop of potatoes, say one rood; and the remaining rood may be put under oats.

The half-acre of roots (turnips and mangolds), if properly managed, will yield ten tons, and afford 1 cwt.

of roots per day for six months, which, with suitable hand-feeding, is quite sufficient for a cow in full milk. By top-dressing, and with the aid of a stolen crop of vetches, the half-acre of artificial grass will not only feed the cow in the house for the six months of summer, but give a little hay for winter use.

509. The rotation may be varied according to circumstances. When the family is large, the whole of the grass field may be put under potatoes, giving this rotation :—

1st year—Turnip and mangolds.
2nd year—Grain, with grass seeds.
3rd year—Grass for soiling, and hay.
4th year—Potatoes.

Roots, after potatoes, require less manure than after lea oats.

In a good climate, potatoes are ripe in the end of September, when they may be dug, and succeeded by Italian rye-grass. On a small farm of deep, sound land we have pursued the following rotation with great success :—

1st year—Turnips and mangolds.
2nd year—Potatoes taken out before the end of September; the ground being then cleared and sown with Italian rye-grass.
3rd year—Italian rye-grass.
4th year—Oats.

Under the circumstances stated, this is a most profitable course of cropping. In one year we fed, from the 4th April until the end of September, four cows on the produce of five (statute) roods of artificial grass raised in this way. To guard against disappointment, it is well to state, for the information of any person who may be disposed to adopt this system, that the grass seed must be sown not later than September, so that the young plants would be strong enough to resist the winter ; and that plenty of seeds must be sown, say not less than four bushels of *pure* seed per statute

acre ; and if there is any reason for doubting the purity of the seed, an extra bushel or two may be used.

510. On light land, Italian rye-grass is so stunted, that the produce of half an acre is not enough to feed a cow during summer. In such a case we have found a plantation of lucerne invaluable ; and when the ground is very light and poor, sainfoin answers better than lucerne. On land of this description we have, in other cases, dispensed with artificial grass altogether, and put in its place occasional sowings of both winter and spring vetches for the summer feeding of the cow.

511. On several cottier holdings the following three-course rotation has been followed at our suggestion with great success :—

1st year—Mangolds.

2nd year—Potatoes.

3rd year—Vetches, viz :

(*a*) Winter vetches, sown in September and October of the previous year, after the potatoes. These vetches will be fit for use in May, and may be succeeded by Swedish turnips.

(*b*) Spring vetches, sown in succession, as explained elsewhere. Vetches sown in January and February may be followed by turnips. Vetches sown as late as May will not be out of the ground in time to obtain another crop within the year, but will afford food for the cow until the mangold leaves become available.

With the aid of cabbages from the cottage garden, and of the produce of the plantation of lucerne, and of cake and bran, when necessary, the cottier farmer will not find any difficulty in feeding his cow from April till November, when the roots become available.

512. On cottier farms horse labour is inadmissible, except for taking out the manure and bringing home the crops ; and even this can be done with the aid of a jennet or donkey.

513. The essential implements consist of spade, steel digging-fork, hoe, and shovel for field work; bucket and wheelbarrow, and, when they can be afforded, a root-cutter, a hand-cart, and a machine for cutting straw into 'chaff.' In due time a metal boiler will be also necessary to prepare hand-feeding for the cow; but for the present this can be done in the kitchen. There should be a strong wooden or stone trough for mixing and preparing food. A few other small articles will also be necessary.

514. The offices required are a cow-house, pig-sty, a store-room, and places for poultry and ducks.

515. The dairy utensils would consist of a milking-pail, a couple of milk-pans, a strainer, a skimmer, and a small churn. The pail should be made of wood, with galvanized iron hoops. A cooler made of tinned iron is very suitable for cottier farms. It is cleaned by dipping it in cold water, and rubbing it lightly with a piece of sponge or fine cloth. When hot water is used and the vessel roughly scrubbed, the tin wears off. A good churn for this class of occupiers is the *atmospheric*, described at page 83, and which is generally made of thick block-tin, and in which the butter is produced by pumping air into the milk. The whole milk is put into the churn at a temperature of 60°; the butter is obtained in five or six minutes; the buttermilk is not sour, and the butter itself is sweet; but, like all butter rapidly made, it does not keep long. For churning cream in small quantity, the American box-churn is the best. On cottier farms there is generally great want of proper dairy accommodation; even when a separate apartment is built as a dairy, it is so cold in winter that it is difficult to make good butter. The atmospheric churn, by admitting of being placed in a tub of hot water during the process of churning, obviates this difficulty to a great extent. In summer, again, it almost invariably happens that the apartments used as dairies by cottagers are

too warm: and in this case the atmospheric churn may be plunged in cold water. When there are no proper means of keeping down the heat of the dairy in summer, we have found that sweet cream and good butter can be produced by raising the new milk to a tempertaure of 170° before setting it in the coolers.

IV. A FARM OF SIX ACRES.

516. We now proceed to detail the cropping and management of a spade labour farm at Glasnevin. The soil is deep, and above an average in point of natural fertility. The farm consists of 5 acres, 2 roods, and 16 perches, within a ring fence, a small paddock containing 1 rood, 20 perches, and a bye-corner containing 21 perches, cropped with lucerne, which is most useful in helping to keep up a supply of green food for the cows. In severe seasons, for instance, grass is later than usual; and lucerne, which becomes fit to cut early in April, and fully a fortnight before the grass, is invaluable. The second cutting of grass is also often late, and the second crop of lucerne again comes in opportunely between the last of the first, and the beginning of the second cutting of artificial grass. A stolen crop of vetches is also useful at this period.

517. In the spring of 1862, this piece of land was in permanent grass, and having been used for several years previously as a paddock for young stock, the building up of their frames reduced it so much in condition that it was the poorest part of the land at Glasnevin. It was divided into four equal parts, put under rotation, the first year's crops being :—

1st. Root crops—turnips and mangolds—for which the ground was dug to the full depth of a spading, at a cost of *3d.* per square perch (statute).

2nd. One-fourth was put under potatoes, which were grown in lazy beds; these were followed early

in October by Italian rye-grass, which was fit for use next April.

3rd. One fourth was put under lea oats.

4th. The remaining fourth was left in grass. In February it received a top-dressing (at the rate of 2 cwt. per statute acre) of Peruvian guano ; and some Italian rye-grass seed was harrowed in at the opening of mild weather in spring. In consequence of this treatment, the grass was fit to cut for house-feeding in midsummer, when a cheap cow was purchased, and with the proceeds of her milk a second was bought. Before the end of the year the capital had increased threefold. As soon as the roots became fit for use, towards the end of autumn, the cattle were increased to three, which number is now maintained all the year round. The result of the first year's operations was, that after charging a rent of £3 19*s.* 3*d.* per statute acre, and £24 10*s.* 10*d.* for hired labour, there was a balance of £33 13*s.* 5*d.* in favour of management.

518. This farm has been worked on the four-course rotations since 1862, and it is at present the cleanest, the richest, and one of the best tilled pieces of land in Ireland. Its condition is now better by £8 an acre than it was then, and this increase is the result of deep and efficient tillage and of liberal manuring. Its improved condition may be described as floating capital put into it by the tenant ; and it is the interest of the landlords, and of the community at large, that the amount of this capital in the soil should be as high as possible. It is a most powerful instrument of production, and it is the best guarantee the landlord can have for the punctual payment of his rent. In Belgium, and on the well-managed farms of the United Kingdom, the amount of this floating capital sunk in the soil is enormous. There are in Ireland close on ten millions of acres capable of cultivation ; and if all were tilled and manured as well as the piece of land we are describing, the tenants' floating capital in it, of which

we are now speaking, would be increased to an average of £5 an acre, or £50,000,000 before ten years.

519. It is unnecessary to describe every step taken during the past twelve years to bring this little farm into its present state. It is enough to give a concise account of its working. With the view of exhibiting as simple a system as is consistent with the object in view, the crops raised are few. The roots are confined to mangolds and turnips; oats is the only grain crop raised; the artificial grasses consist of Italian rye-grass and a little red clover, together with a patch of lucerne. The small farmer must have potatoes, and in many parts of the country flax is a valuable adjunct; accordingly, we have shown where these crops can be introduced into the rotation. As regards flax, the author wishes it to be distinctly understood that its cultivation is not an essential part of a system of management for improving the condition of small farmers. It is, in its own proper place, a most valuable and profitable crop; but there are many instances in which the small farmer would do better without it.

520. We have now to make some observations on each of the crops raised. The common four-course rotation is, as already explained, the basis of the systems of modern husbandry most extensively practised; it is sound in principle, easily understood, and admits of very general application. We have, therefore, modified this rotation into the following scheme, which gives the cropping of one field for four years in succession:—

1st year—Root crops, mangolds and turnips.

2nd year—Oats, with seeds. The ground being now rich, a strong growing variety of oats is used, so that it may not lodge and rot. It has been already stated that on rich land no artificial grass is equal, in a moist climate, to Italian rye-grass, both as regards certainty and produce; but on light, dry ground, or in a warm climate, red clover, which has deep roots, and is more

independent of surface moisture, gives a better return. To prevent clover-sickness, one-half the field may be put under rye-grass, and the other half under a mixture of rye-grass and clover; and four years afterwards the places of these crops should be changed.

3rd year—Artificial grass for house-feeding cows during the summer, and for hay.

In the 4th year the crop, in the ordinary course, would be oats, commonly called lea oats; but the field may be subdivided into three parts, and cropped thus :—

(*a*) One part lea oats, which illustrates the original rotation.

(*b*) One part may be put under flax, the ground being dug deeply and early.

(*c*) The remaining part may be devoted to potatoes.

When, four years afterwards, the same crops come round on this field again, the flax should be put where the potatoes are now; lea oats should be sown where flax is now, and the potatoes where we have now lea oats. Four years later, the crops are again shifted in the same way, so that flax would occur only once in twelve years, by which fibre of good quality is obtained. Flax should not be grown where a good market for it does not exist.

521. With the exception of mangolds, all these crops can be successfully raised in every part of the country; and where, as in mountain districts, the climate is too wet or cold for the mangold crop, turnips can be substituted for it.

522. One-half of the farm is devoted to crops for cattle-feeding—namely, one-fourth to roots for winter, and one-fourth to grass for summer, use. The cows are house-fed throughout the year. A small paddock, containing 1 rood and 20 perches, has been recently added to the farm, so that henceforward they can be let out morning and evening for exercise. If the farm were larger, we should increase the paddock, so as to

give the animals more exercise. Our experience at home, coupled with observations in Belgium, go to prove that much exercise is not essential for the secretion of milk, or even for the health of full-grown animals; but a paddock is necessary when the small farmer rears stock.

523. Many persons are astonished when they are told that three cows are maintained all the year round on this little farm, or rather upon the produce of one-half of it. The following facts will make the matter very simple.

The roots are fit for use in October, and continue sound and good up to April, and longer if required—say, in all, six months, or $182\frac{1}{2}$ days. The quantity of roots given to the cows varies from six to eight stones each daily, according to the condition of the beasts. Taking the average at 7 stones a day, we require for each beast 8 tons for the half-year, or, for the three beasts, 24 tons. Any practical man knows that an acre of good land, tilled and manured as it ought to be, must produce upwards of 20 tons per statute acre; even at this average, the yield of the field of roots would exceed the wants of the animals. In addition to roots, each cow gets from $3\frac{1}{2}$ to 7 lbs. of hay, and from 2 to 4 lbs. of what is called concentrated food in the day; the kind and quantity of this food depending on the condition of the animal. For the production of milk, a mixture of bran and cotton-cake is the best artificial food. The cake is broken very fine, and then mixed with the bran; the mixture is steeped over-night in cold water, and in the morning a little warm water added to reduce it to a lukewarm mash. For strippers intended to be fattened off, linseed oil-cake, broken fine, is the very best food. Good rape cake may also be used with advantage; when broken, boiling water should be poured on it to dissipate a peculiar pungent substance it contains, and which makes it distasteful to animals. Oats, when

cheap, should be crushed and made into mashes, the same as bran; judiciously used in this way, it is worth anywhere 10*d.* a stone.

524. Italian rye-grass is fit for use in April, or early in May. It invariably produces two crops or cuttings; in average good seasons it yields three, and when the season is particularly favourable we obtain as many as four crops. For obvious reasons it should not all come in at once. Accordingly, a third of it is top-dressed with Peruvian guano early in February, at the rate of $1\frac{1}{2}$ cwt. per statute acre, and the remaining two-thirds at intervals of a fortnight.[1] The result of the top-dressing is, that we soon perceive three distinct divisions in the field; and these divisions can be used in regular succession. After each cutting, a top-dressing of the same manure is used: the last work done every day being to top-dress the part mown that day, the manure being broken very fine, and applied at the rate of 1 lb. or $1\frac{1}{2}$ lb. per square perch. The night's dew helps to wash it into the soil before the heat of next day's sun could do it any harm. By this mode of treatment, the artificial grass yields a somewhat heavier produce per acre than the roots; and, as the daily allowance of grass is about the same as of roots, we find that, with the aid of the plot of lucerne and some purchased or concentrated food, the field of grass not only supports three cows for the summer half-year (April to October), but yields hay enough for the whole year.

525. When either roots or artificial grass are scarce, the cattle can be made to keep up their milk and condition on hay and artificial food, or on what may be called hand-feeding. In the middle of July, for instance, in a dry year, when the grass is very back-

[1] We have, of late, used sulphate of ammonia, owing to the difficulty of getting good Peruvian guano. In hot weather we find nitrate of soda rather better than either, as a top-dressing for grass.

ward, we have provided the following feeding for a number of cows on another farm :—

6 o'clock a.m.—$3\frac{1}{2}$ lbs. of bran in mash, with hay afterwards.

12 noon—2 lbs. of bran, 2 lbs. oil-cake made into mucilage, mixed with 5 lbs. chaffed hay, and the whole given in a moist state.

6 o'clock, p.m.—Same as morning feed.

9 o'clock, p.m.—A small quantity of hay.

Water *ad libitum*.

On this feeding cows milk freely, and put on flesh and fat. When a chaff-cutter is used, and particularly in time of scarcity, it is useful to mix cut cabbages, rape, or green food of any kind with cut hay or straw.

526. We are continually asked if the straw produced on the farm is enough for bedding the cattle all the year round and the answer is in the affirmative. Owing to the treatment the land receives, the yield of straw is very heavy. Sometimes it is so rank as to be liable to lodge, which injures the grain; to prevent this we clip off, with a sickle, the tops of the plants before the ears begin to appear. In the driest season, the produce of straw on this farm is upwards of two tons per statute acre, and the total quantity produced is enough to litter the animals comfortably for twelve months. In summer, we have limited the amount of bedding to a quarter of a stone of chaffed straw per day for every beast. When necessary, we do the same in winter. The scouring of ditches and sawdust may be used if the straw should run short.

527. The manure produced from the three cows is enough for the field of roots and the plot of potatoes. A house-fed cow produces, as already stated, at least one ton of manure per month; by our management more is obtained. If the manure should at any time run short, the deficiency can be readily supplied by using artificial manure for turnips.

528. It is well to consider the capital required to

start this little farm. We must not overlook the buildings, without which the experiment could not have succeeded. Then, as regards labour, it is to be borne in mind that, excepting horse labour, the greater part, if not the whole of it, would be supplied by the small farmer and his family. Seeds and manures are very generally supplied on credit for three or six months by the most respectable houses; and the small farmer, when he requires it, will be able to procure reasonable credit for the purchase of these necessaries. Excluding buildings, the capital with which the farm was commenced consisted of:—

1st—An outlay for hand implements of . £1 10*s.*

2nd—The price of a cow . . . £13 0*s.*

3rd—The small farmer would, in addition, require as much money in hand as would support himself and his family, until the produce should become available. This item will vary with circumstances, such as the time of entry on the farm. In discussions on small farms, the word *capital* has often been used in a way which has caused misconception. Capital is necessary to every employer of labour; and no man should start in the management of a farm, however small, without a suitable amount of it. The defective state of our small farms is not, however, owing to want of capital, as is evidenced by the fact that many of them have been in the habit of investing money in banks at a very low rate of interest, or allowing it to lie idle in their houses. Labour is the great agent which produces capital; and there is in all small farm districts an enormous amount of agricultural labour which is not producing anything like the wealth of which it is capable.

529. We have now to consider the income derivable from our small farm. The labour represents the work of a man and a boy. *They find continuous employment on it throughout the year.* While, in summer and winter, small farmers are idle, the hands on this farm

are as busy as in spring or harvest. As our markets are exceptionally favourable, we shall give the results in a remote district. An ordinary cow, fed and treated as we have suggested, produces upwards of 600 gallons of milk in the year. Let us take it at 500. In any part of the kingdom milk is worth at least 6½*d.* a gallon for butter-making, and for the feeding of pigs and calves. The value of the calves when dropped may be put down as a set-off against casualties.

	£	*s.*	*d.*
Three cows would produce 1500 gallons at 6½ per gallon	40	12	6
The oats, after roots, produce on an average more than 160 stones, which are worth, say 10*d.* a stone, or for the field	9	6	8
Assuming that one-third of the stubble ground is cropped with flax, we have 1R. 34⅓P. at 5 cwt. per acre = 18½ stones at 7*s.* 6*d.*	6	18	9
Value of flax seed, say for feeding	2	0	0
Lea oats—1R. 34⅓P. at 140 stones per acre = 65 stones at 10*d.*	2	14	2
Potatoes—1R. 34⅓P. at 6 tons per acre = 2 tons 16 cwt., at 4½*d.* per stone	8	8	0
Profit on pigs (a very low estimate)	5	0	0
Profit on poultry	2	0	0
Total value of produce	£77	0	1
From this we must deduct rent, at £2 an acre	11		0
Seeds—			
Green crops	0	7	6
Potatoes	1	5	0
Oats	1	0	0
Flax	1	0	0
Artificial grass	1	10	0
	5	2	6
Wear and tear of implements	2	0	0
Cost of artificial manure, 6 cwt. Peruvian guano, at 13*s.* 6*d.*, or its equivalent of sulphate of ammonia or nitrate of soda	4	1	0
Cost of artificial cattle food	6	0	0
Hired horse labour, &c.	3	10	0
Total of out-goings	32	2	0

Deducting this from the value of the produce, there remains a balance of £44 17*s.* 4*d.*, or a fraction above 17*s.* 6*d.* per week, which is available for the maintenance of the farmer and his family. These figures may appear to prove too much to persons who have had no practical experience themselves of the capabilities of small farmers. We beg to assure those persons that the case has been advisedly understated. There are several small farms under the author's inspection on which the results considerably exceed those given above. The whole secret may be summed up in one short sentence: The tillage is deep, clean, and efficient; and the cattle are fed with care and skill.

530. It is not to be inferred that farms of the size described are recommended in preference to larger ones. A discussion on the minimum number of acres which a farm should contain is foreign to this work. Vast numbers of people are planted on small farms throughout the country, and the great question is, how best to improve their condition. Without offering any opinion of a controversial character, we would take leave to say that, when a holding is large enough to give continuous employment to an able-bodied man, and occasional employment to members of his family, its skilful cultivation is sure to enable them to pay their way and to live comfortably.

V. ONE-HORSE FARMS.

531. A holding which cannot be properly tilled without the use of horse-power, but which is not large enough to employ a pair of horses, may be called a one-horse farm. All operations that require a pair of horses, such as ploughing, are performed by hiring a second horse, or by co-operation; that is, two neighbouring farmers agree to make up a team, which is employed first upon one and next upon the other farm.

A difference must occasionally arise as to who shall get the first turn, but, by mutual forbearance, the work progresses in a satisfactory manner. The ploughing of land in autumn, in preparing it for roots and potatoes, is better done by three than by two horses where the ground is sufficiently deep to permit of deep ploughing; but there is no reason why farmers, each owning one horse, could not combine to make up a team of three, or of four or more horses. The author has had experience of several one-horse farms; and he can say that by a system such as has been explained, excellent crops have been obtained. It is not to be inferred from this remark that the author favours this class of farms. The truth is, if called upon to subdivide an unoccupied estate, he would avoid them, partly because the second horse cannot always be procured when work is urgent, and partly because they require a relatively large amount of capital. Thus, for example, those essential implements of tillage—the plough, harrow, roller, and grubber—will cost as much on a one-horse as on a two-horse farm. In Ireland this class of farms is very numerous; and in England many of our villa farms may be said to belong to the same category.

532. A one-horse farm may contain from ten to thirty acres, or more, according to the quality of the ground. Part of the farm will be in permanent pasture. Farms of this size rarely afford a sufficient run for sheep. The best plan is to depasture the permanent grass with milch cows or young cattle. Pasture land, which is low-lying and cool, answers best for milch cows, and should be used for the production of butter. There should be a good-sized paddock for calves, and, if possible, a smaller one for pigs. The remaining portion of the farm should be cropped in accordance with some established principle. The simplest rotation in use is the four-course already described. On medium land, such as the greater part

of the soil resting on the mountain limestone the five-course rotation answers very well. The crops follow each other in the following order :—

1st year—Turnips, mangolds, and potatoes.

2nd year—Grain, with grass seeds.

3rd year—Grass, which may be partly made into hay for winter use, and partly used for feeding milch cows in the house, during the hottest part of the day, in summer.

4th year—Grass for pasture.

5th year—Lea oats.

The second year's grass is never as productive as the first. It is rarely heavy enough for meadow. Hence it is depastured, and this presupposes the existence of fences to confine the animals.

533. On upland or mountain ground, the following six-course rotation answers still better :—

1st year—Root crops generally, turnips and potatoes.

2nd year—Grain, with grass seeds. The oat crop is generally selected, being the most certain in upland districts.

3rd year—Grass for meadow; part may be given green to the milch cows in the house in hot weather.

4th year—Grass the second year, which is depastured.

5th year—Grass the third year, also depastured.

6th year—Lea oats.

In many cases it will be better to break up a field of lea just as it wants it, irrespective of the number of years it is in grass, as we shall more fully explain further on.

534. A calf may be reared for every milch cow kept. Should the farmer be so unfortunate as to have cows of a bad description, he should not rear his own calves, as it is a mistake to waste good food and labour on animals of an inferior description, while good ones can be had everywhere at a moderate price. After a few years, it is quite possible for every farmer to come

into possession of a good class of cows, after which he may rear all the calves. By this rotation, a large quantity of straw, and a fair share of hay, can be produced for winter feeding. There will be on the farm a number of dairy cows, of three-year-old heifers, of two-year olds, and of yearlings. A breeding sow may be kept, and when young pigs are in good demand, it would pay to keep a second. Each sow should be so managed as to give two litters in the year. One litter should be fit for weaning when the buttermilk begins to be plenty in May; and the second litter should be forward enough to consume the small potatoes.

535. It may be useful to give some details of the working of a well-managed one-horse farm. It is situated near a town, and contains 23 acres, 2 roods, 2 perches of arable land, of fair quality. Buildings and roads occupy 3 roods, 37 perches; the garden contains 1 rood, 5 perches; an area of 7 acres, 3 roods, 26 perches is in permanent pasture for dairy cows; and 14 acres, 1 rood, 10 perches are under rotation. One horse is kept; and all work, such as ploughing, which requires more than one horse, is done with the aid of a hired horse, or one is employed on the co-operative principle explained. The implements are as few as possible; and a system of tillage and stock feeding is pursued, suited to the great bulk of the working tenant farmers. The live stock consists of one horse, seven milch cows, and a breeding sow, and sometimes two. There is good demand for new milk, at 2*d.* a quart; and it is more convenient to sell it at this price than to rear calves. A couple of the calves from the best milkers are, however reared.

536. The crops raised, and the returns obtained from them, are as follows:—

	£	s.	d.
1 Turnips and mangolds, 3A. 3R. 10P.; the produce is consumed by the stock.			
2 Artificial Grass, 3A. 3R. 10P. Of the produce, part is used in a green state, and part made into hay.			
3. Oats, 6A. OR. 30P.; the yield is fully 75 barrels, at 14*s.* per barrel	52	10	0
Deduct for horse feeding £10 0 0			
,, seed 3 10 0			
	13	10	0
	39	0	0
4. Potatoes, 2R.	15	0	0
5. Garden produce, 1R. 9P.	10	0	0
6. Pigs	20	0	0
7. Poultry	5	0	0
8. Dairy produce, 7 cows at £18	126	0	0
	£215	0	0

The value of the calves is more than an equivalent for deterioration in the value of the cows arising from age or other casualties.

537. By keeping a young horse, and by the exercise of skill in his purchase, the farmer often sells him at a good profit after the season's work; but as all farmers could not do so, it has been left out of the receipts.

538. The expenses consist of—

	£	s.	d.
Seeds of root crops	1	10	0
,, grasses	2	9	0
Artificial manure	5	10	0
Feeding stuffs	12	0	0
Repairs of implements and horse-shoeing	5	0	0
Sundries	5	0	0
Rent	52	18	0
Balance in favour of labour, skill, and capital	130	13	0
	£215	0	0

539. An industrious farmer, with the aid of two or

three sons, according to age, could perform all the manual labour of this farm. Under the present management the payment for labour is—

	£	s.	d.
A permanent labourer, 10*s.* a week, or, per year	26	0	0
A permanent woman, 5*s.* a week, or, per year	13	0	0
Extra hands, 150 days at 1*s.* 6*d.* . . .	11	5	0
	£50	5	0

leaving a balance of £80 8*s.* in favour of capital and management; this income in the case of a working farmer, would be increased by the amount of the labour performed by himself and his family.

540. A two-horse is larger than a one-horse farm. The main features of the management of both are the same. As a rule, the occupiers of this class of farms, which vary in size from 40 to 60 acres of arable land, put their own hands to the plough, live frugally, pay high rents, and are well able to meet their engagements.

VI. A FARM OF 140 ACRES OF GOOD DEEP LAND.

541. The size of this volume precludes us from giving many illustrations of large farm management. A few typical examples will, however, be useful. Our first is a farm, which contains 140 acres of deep sound land, and which has been under our direction for several years. The soil is a moderately rich friable loam, resting on a deep clayey subsoil. The greater part of the land has been drained, the drains being 24 feet apart, and from $3\frac{1}{2}$ to 4 feet deep.

542. The farm is an irregular strip of land, about three-quarters of a mile in length. Both ends are in permanent pasture, and, together with a few paddocks adjoining the buildings, comprise an area of 56 statute acres. The remainder is under a systematic course of

cropping, which may be described as a modified four-course expanded into an eight years' system. The order of succession is as follows:—

1st year—Mangolds raised with farmyard manure.
2nd year—Wheat or oats, laid down with rye-grasses.
3rd year—Hay. The after-grass is fed off with sheep.
4th year—Potatoes raised with farmyard manure, Part of the field may be cropped with oats, beans, &c., according to circumstances.
5th year—Turnips. When this crop follows potatoes, it is raised with artificial manure.
6th year—Barley laid down with a mixture of rye-grasses and clovers.
7th year—Grass for hay. The aftergrass is fed off with sheep.
8th year—Lea oats.

543. The field intended for mangolds is scarified with Clay's cultivator as soon as the lea oats is removed; and all scutch and other root-weeds picked off. It is then deeply ploughed with a strong plough fitted with a high mould-board. Three strong horses work abreast, and turn over a furrow to the depth of ten or twelve inches. A little of the subsoil (about an inch, sometimes less, seldom more) is brought to the surface by this operation. The succeeding frosts and thaws of winter liberate a quantity of plant food before spring.

544. Wheat succeeds mangolds when the season admits of its being sown in time. As soon as the mangolds are removed the soil is ploughed, six inches deep, across the direction of the drills. A few strokes of the harrow prepare it for the ribbing-plough, which is generally used for putting in the wheat. The wheat is sown broadcast over the ribbed surface, at the rate

of ten stones to the acre. A stroke of the harrow along, and another across the ribs, cover the seed.

545. The grass-seeds sown in this division consist of one bushel perennial, and two bushels of Italian rye-grass per statute acre. The rye-grasses are surface-rooted plants, and thrive best when there is plenty of manure in the surface, which is the case after the liberal application of dung used for the mangolds.

546. The preparation of the lea land for potatoes is as follows :—

Two ploughs are made to follow each other ; the first, drawn by one horse, takes off two or three inches of the surface and throws it into the furrow ; the other plough, drawn by two and sometimes three horses, turns the sod on top of this ; both together stir the soil to a depth varying from ten to twelve inches. The land treated in this way is, in the following spring, easily prepared for drilling with the grubber and harrow. The drills, for both potatoes and mangolds, are made twenty-eight inches apart ; those for turnips being twenty-six inches wide. As soon as the potatoes are stored, the land is deeply ploughed for turnips, which, as before mentioned, are raised with artificial manure, the supply of home-made manure being all used for the potatoes and mangolds. Two cwts. of nitrate of soda, four of mineral superphosphate, and two or three of kainit, per English acre, are found to be an excellent artificial mixture.

547. It will be seen that turnips do not recur on the land, in this rotation, oftener than once in eight years. When raised on the same land every fourth year, the crop is liable to 'anbury' and 'finger and toe ;' but by extending the period to eight years, turnips do not suffer from either of these affections. It will also be seen that the clover plant is introduced into the rotation only once in eight years. Previous to this arrangement it was impossible to get a uniformly

healthy crop of clover to grow. A good plant is now always secured. The deep cultivation has, no doubt, helped to bring about this result ; but it is mainly due to the extension of the period of the recurrence of the plant on the land.

548. The wire-worm, as is well known, destroys a very considerable part of oats raised on lea. The farm we are now describing was no exception to this rule, until it occurred to the writer to prepare the land in the way above described for potatoes. The grass is skimmed off and completely buried in the last made furrow by the furrow-slice taken by the plough which follows. Instead of using two ploughs for doing this work, we have occasionally done it with one plough fitted with a strong and specially-made skim coulter, and drawn by three horses. The grass must be buried to the depth of at least six inches.

549. All grain crops, except wheat, are put in with the corn-drill in rows seven or eight inches apart ; oats at the rate of eight stones per statute acre after manured crops, and ten stones after lea ; and barley at the rate of eight stones per acre.

550. The extent of land under rotation is about 80 acres ; a fourth of this is under roots, three-eighths under grain, a fourth in artificial grass, and an eighth under potatoes. A few acres of winter vetches are grown for the use of horses and milch cows.

551. The live stock consist of three farm horses, thirty milch cows, ten yearlings, ten two-year-olds, a number of well-bred pigs, fifty breeding ewes, and a flying flock of fifty or sixty sheep to eat down the after-grass.

552. The farm horses get, in addition to hay, two feeds of oats of six pounds each, and a mash of steamed food, or a feed of carrots at night, for about eight months of the year. During the four summer months, they get one feed of oats daily, with grass or

vetches. The winter's mash is made up of steamed mangolds or turnips, of chaff, and concentrated food.

553. The greater number of the dairy cows have several crosses of pure shorthorn blood in them. There are a few pedigree animals in the herd which have been purchased at favourable opportunities at a trifle above the price of common stock.

554. Ten of the heifer calves from the best cows are reared every year; and the rest of the calves are sold to farmers at remunerative prices. The cows are pastured during the summer and autumn. In the warm weather of June and July, they are put into a shed for three or four hours, in the hottest part of the day, and supplied with vetches or rye-grass. Towards the end of autumn, when the nights get long and cold, and the ground wet, they are housed at night, and fed on hay and white turnips. From the first of November, when the grass gets bare, they are fed in the house both day and night; and receive daily two feeds of prepared food and one feed of raw roots. The prepared food consists of a mixture of pulped roots, and chaffed or cut straw, and a little concentrated food, such as cake or corn. This feeding is continued throughout the winter season. As regards the roots, the turnips are used first, and the mangolds afterwards. The cows in full milk get in this way, about seven stones of roots daily in addition to the other substances named. Cows forward in calf, or dry cows, get only one feed of roots daily together with hay. Springers are let out to exercise every mild day. Some of the old or indifferent milkers are fattened off towards spring, when beef is dear; and their place is filled up by some of the young stock.

555. Calves are reared from the pail. They get new milk for two weeks: after that age, it is gradually withdrawn, and a mixture of skim-milk and linseed meal mucilage supplied in its place. The skim-milk and meal are given until the animals are four months old,

and sometimes longer. They are mixed in the proportion of six quarts of skim-milk to a pound of linseed meal, and given in two feeds daily. When the nights get cold, the calves are taken into the house, and supplied with pulped roots, oil-cake, and hay. This feeding is continued throughout the winter. One pound of cake, two stones of roots, and as much hay as they eat, constitute their daily keep in winter. In the following summer they are put out on grass; and in the succeeding winter they have access to an open shed, into which they go at night, and where they are supplied with plenty of good straw in the early part of the season, and with hay later on. No roots are given, but the pasture is well stocked with old grass which, together with the straw, keeps them in good condition.

VII. FARMING ON A LARGE SCALE.

556. The examples of farm management described in the foregoing pages being under our own immediate direction, we now propose to draw a few illustrations from other sources. We have carefully inspected a great many farms in each of the four provinces of Ireland; and, overlooking the fattening lands, which are used for grazing purposes, and upland farms devoted to raising stock, we have invariably observed that a mixed system of tillage and grazing, such as we recommend, pays best. The system requires, however, more capital, acre per acre, than mere grazing. It also involves more varied knowledge, a great deal more skill, and more constant and active supervision on the part of the occupier than pastoral farming. But it is beyond all controversy that a man with a fixed capital who possesses the necessary skill, energy, and industry, will realize a higher percentage by investing that capital in arable or mixed farming than in grazing. It is, however, great folly for any

person to embark extensively in tillage farming who does not possess the qualifications we have named.

One of the best managed large farms we know is in County Mayo, and contains 2200 statute acres.

557. The history of the farm possesses great public interest. The average rainfall is 37 inches; in 1872 it was as high as $52\frac{1}{2}$ inches. The occupier has aimed at making the largest profit on his capital.

558. Of the entire area, 1800 acres are arable, and 400 acres consist of 'bottom' land or cut-away bog. Of the 1800 acres of arable land, 300 are kept in permanent pasture for sheep, and 1500 under a system of convertible husbandry. Turnips are often raised after grass, the surface being skimmed and buried by a deep furrow, as already explained.

559. In this case turnips are followed by wheat with which grass-seeds are sown. Sometimes again the succession of crops, after lea, is—

1st—Oats.

2nd—Turnips.

3rd—Barley, or oats, with seeds; followed by grass for two or three years.

560. The variety of wheat sown is Grace's Champion. The mixture of grass is—2 lbs. Alsike clover, 2 lbs. yellow clover, 4 lbs. white clover, 4 lbs. American red clover, 4 lbs. Timothy, 6 lbs. cocksfoot; with 5 lbs. Italian and 8 lbs. of Pacey's perennial rye-grass.

561. There are generally 220 acres of turnips, and about twice as many acres of grain.

562. Twenty-six working horses are kept. A cross of the Suffolk Punch with the Clydesdale is highly esteemed for draught.

563. Sheep form the main source of income. A flock of 1000 ewes is kept; and about 1000 head of sheep of all ages are annually sold. Two hundred tons of turnips are stored for the use of the ewes from the 1st January to the lambing season. In severe

seasons they get a little hand-feeding in addition. Last year, for instance, each ewe got a mixture of ½ lb. bran and 1 lb. oats daily from the 15th January to the 10th March.

564. In autumn, 350 of the best of the ewe lambs are selected to take the place, next year, of old ewes; the rest are sold. The lambs are weaned in the second week of July; after which they are put on the second or third year's grass. It is found that calves or lambs are liable to suffer from worms in the bronchial tubes if fed on the first year's grass. About one third of the old ewes are 'culled' out of the flock every year. Some of these are sold to Leinster farmers and graziers, who obtain from them a crop of 'market' lambs for the butcher, and sell them fat soon after the lambs.

565. The wether lambs, and a number of sheep are fattened during winter on turnips. As a preparation for the turnips they are fed on cabbage, of which about eight acres of the Drumhead variety are raised. The crop is consumed on the land, the sheep being folded by nets, and getting hay in movable racks. When the cabbage is consumed the sheep are fed on turnips; the animals which are forward in condition get each, in addition, 1 lb. of a mixture of linseed cake and crushed oats and barley, together with hay.

566. Of black cattle, 120 are fattened every year. These consist of twenty animals reared on the farm. Being of good quality, and liberally fed from the commencement, they become fit for the butcher at the age of two years and a half: some of them under this age. We advocate an extension of this system as one of the means of meeting the increasing demand for flesh meat.

567. One hundred bullocks are purchased in October each year, at two and a half years' old. They are put on the coarse bottom lands till February, when they are housed, and fed on oat-straw, together with

an allowance of 3 lbs. per beast daily of a mixture of crushed oats and barley. In fine weather they get a run on the bottom lands, and in May they are put out altogether on these lands, and kept there till October, when they are again housed and stall-fed. The usual daily allowance for each animal is eleven stone of turnips, together with artificial food. The turnips are given twice a day, namely, at 5.30 A.M. and 2 P.M. At 11 A.M. the artificial food is given. At first, it consists of 1 lb. of cake, and 2 lbs. of a mixture of crushed oats and barley and light wheat. After Christmas the quantity of cake is increased to 3 lbs. A little hay is given to them for the first six weeks; and they are supplied with good oat or wheat straw throughout.

568. These animals are sent to market from January till March. They pay at the rate of £1 a month for their keep from the date of purchase.

569. The arable portion of this farm, under present management, produces four and a half times the rent; if kept in permanent pasture it would not produce more than twice the rent. This simple fact is very suggestive, and clearly indicates one of the ways in which the agricultural wealth of the country could be increased.

570. We shall now describe the system of management pursued in the reclamation and management of a large tract of land in the County Galway. The whole extent in hand is 1700 statute acres, divided into three holdings: namely, Coolarne and Cahertimore, situated five miles north-west of Athenry, containing 1450 statute acres, of which 1250 are always in pasture, and the remaining 200 acres are under a course of tillage. Oranmore, containing 100 acres of good land, all in grass, is situated four miles to the east of Galway town; and Belgard, situated near Kilcock, Co. Kildare, within twenty minutes' drive by rail of Dublin, contains 150 statute acres of very rich fatten-

ing land. Both Oranmore and Belgard are mainly used for fattening the sheep bred and reared at Coolarne.

571. The lands of Coolarne and Cahertimore had been formerly let to small tenants under the Court of Chancery, and were badly farmed. The famine years left the lands tenantless. It then changed hands. The greater part of it was covered with heather. The new proprietor commenced to reclaim the coarse and inferior ground. The heather was cut away with the scythe or hook, and carted into the yards for bedding cattle, or for being put under manure heaps. A piece was fenced in at once, all rough stones removed from the surface, and then let in small plots of an acre or half-acre to the labourers of the surrounding districts, the rent being the cost price of the Peruvian guano with which it was manured, at the rate of 6 cwt. per statute acre. The owners of these plots turned over with the 'loy' (or long spade) the tough sods which would have resisted any of the ordinary implements of cultivation. On this sod they planted the potatoes, and covered them with clay from the furrows. The proprietor supplied those that had not good seed of their own with all they required, at market price, giving them till November for payment. The furrows were deeply trenched in moulding the potatoes. After the crop was dug, the land got a good ploughing, but not so deep as to bring up the sub-soil; and it was left in this state during winter. In spring it was harrowed and cross-ploughed, and sown with rape and turnips, which were raised with the aid of a good dressing of artificial manure. In the following winter it was ploughed much deeper than the previous year, and a crop of oats was put in, and laid down with clover and rye-grasses. With the addition of a little top-dressing of bone superphosphate, which was manufactured on the farm, the oat crop generally gave a very good yield. In the following season, with a little additional top-

dressing, a good crop of meadow was obtained. The following year it was fed with sheep; and early in winter it was sub-soiled, and quick-lime spread on the surface during the winter, at the rate of 60 barrels per acre. This was harrowed down in spring; the land was then cross-ploughed, and a crop of mangolds and turnips taken off the entire field. The following year it was sown with oats, and laid down to permanent pasture. An area varying from 40 to 70 acres was reclaimed in this way every year.

572. Notwithstanding that several fields have not been stirred since the land was laid down to grass after reclamation, they show no signs of returning to the heather. Part of the land thus improved is capable of carrying four sheep to the statute acre.

573. The system pursued at present on the tillage land is well adapted to the circumstances. The permanent grass is never abundant until the middle of May or 1st of June. A large area of roots and other green food is absolutely necessary to carry the store and breeding stock through the spring until the grass comes round.

574. The course of cropping may be understood from the following statement. As soon as a field of grass shows symptoms of deterioration, it is broken up, irrespective of the time it has been laid down, and put through a course of cropping which, in the main, corresponds with the system pursued in reclaiming the land at first. It may be stated as follows;

1st year—Potatoes.

2nd year—Rape and turnips, raised with artificial manure.

3rd year—Oats and grass seeds.

4th year—Part hay, and part pasture.

5th year—Pasture.

6th year—Mangolds and turnips, raised with farmyard dung and artificial manure.

7th year—Oats laid down with permanent grass

seeds. The grass is not again broken up until it becomes inferior.

575. The potato ground and the field, broken up after two years' grass, are devoted to green crops, which consist of 25 acres of turnips, 10 acres of mangolds, 20 of rape, 4 of carrots, and 4 of cabbages. The turnips and rape, which are put down after potatoes, are manured with a mixture of equal parts of Peruvian guano, mineral superphosphate, and kainit. The mangolds and turnips, which are sown after two years' grass, are manured with farmyard dung and artificial manure. The mangolds get 25 tons per English acre, turnips 15 tons of manure, and 5 cwt. of the artificial mixture just described, which is spread on the top of the dung with a broadcast distributor. A very strong plough is used for ploughing the grass, and is fitted with a strong subsoil tine, which breaks up the subsoil to the depth of five or six inches. The implement (plough and subsoiler) is worked by three strong horses pulling abreast, and stirs the whole soil to the depth of fourteen or fifteen inches. A man follows and removes loose stones, and marks those that are too firm or too weighty for him. These are subsequently removed. Rape is used for feeding the lambs in October, when the grass begins to run short. Any check to their growth at that season, or, indeed, at any other, would be a great loss; for the stronger they are before winter the better. Twenty acres of this crop are usually sown, and sometimes more. The crop is put down at different parts of the farm, and sometimes different parts of the same field, in order to keep the lambs while on it separated into small lots. White turnip seed is sown in every sixth drill; and this trains the lambs to eat the rape. Four acres of carrots are sown for the use of the horses in winter, and four acres of spring vetches for summer feeding. The vetches are followed by winter cabbages, which are

found to be very useful for the ewes at the lambing season. Borecale, put down a fortnight later than usual, is the best variety. Two acres of large York and Drumhead cabbages are planted in spring for the use of the sheep in autumn. Six acres of furze meadow afford a large quantity of feeding for the horses in winter. Oats is the principal grain crop grown on the farm. It follows the two divisions of roots. As soon as the roots are removed, the land is ploughed to a depth of seven or eight inches. Before sowing, the ground is grubbed and harrowed as often as is necessary, to reduce it to a proper seed bed. A corn-drill is used, the width between the rows being seven inches; but as one drill could not get over all the land in time, the ribbing plough is also used. Eight stones of seed are used with the drill, and ten or twelve on the ribbed surface. The drilled crop is generally better than the ribbed portion. Black Tartary is the variety sown. About 40 acres of the 'seeds' are cut for hay, and the remainder and all the after grass fed off with sheep, lambs, and calves. On about 20 acres of the best pasture sheep are folded and provided with turnips, meal, and cake until about the 1st of April, when it is closed up for hay. In the end of July this land gives a heavy cutting of short, sweet hay, which is very valuable for feeding the flock. The fields vary in size from 14 to 20 acres; and all are well fenced with double stone walls, and at the angles facing the prevailing winds, where there are no plantations to give shelter, the walls are raised to the height of nine or ten feet.

576. Immediately after purchasing this property (which was very bleak, and greatly exposed to westerly winds), the proprietor commenced the formation of belts of planting not unlike the Scotch stells. The work was done during the winter months, when labour was available. There are now 80 acres of

healthy plantations scattered over the farm; the trees are doing well, and affording great shelter during the winter months. In 1873 a sum of £100 was received for the mere thinning of these plantations.

577. The live stock, as may be well supposed, form the principal feature of the management. The regular stock of sheep consists of 500 cross-bred ewes of superior quality. The flock is examined carefully in August, and 130 or 140 of the oldest or worst culled out. The ewes get very little turnips during winter, grass and hay being sufficient to keep them in good condition. After lambing, they are supplied with winter cabbages, pulped turnips, and one pound of meal for each animal; and hay is provided until the grass is sufficient to keep them. A number of fields are always kept closed, and the sheep are changed on these about once a fortnight; the ewes while suckling their lambs, and the lambs after being weaned, are always put on the best grass. After being shorn, the animals are branded and dressed with sheep-wash. The lambs are weaned about the 1st of July, and put on good grass for about three weeks. Fresh water is given during very warm weather in troughs, and the pasture is frequently changed. In October they are netted on rape. Soft turnips are supplied to them as soon as the rape is all consumed; the few roots which were sown with the rape having trained them for living on turnips, as soon as they get them. When they begin to shed their teeth in spring they are supplied with plenty of pulped roots, hay, and a mixture of barley, linseed meal, and locust-bean meal: the latter is relished very much.

578. The roots, chaffed hay, and meal are mixed together and put into a sheep-rack, which has a trough underneath. As the trough is emptied, more of the food falls in from the rack above. This is boarded over, and down the sides, to prevent the

rain from wetting the food, or the wind from carrying away the chaffed hay or meal. There is only a very small quantity of food at any time in the trough, which is constantly supplied as fast as eaten. Fresh food is put into the racks every morning, and any that has not been eaten is taken away and given to the store stock. About half a pound of meal is given to each lamb, and is made up of a mixture of palm-nut, locust-bean, and barley-meal, and sometimes Indian meal and oil-cake, are added so as to vary the food.

579. About two hundred of the most forward of the weather hoggets are sent to Oranmore farm, in the middle of April, and are there put into improved condition. They are then sent to Belgard to be finished, and are sold in Dublin in August and September. The others follow in regular succession, and are sold off before winter, except a few scores which are fattened at Coolarne on turnips, and sold during the spring. They weigh on an average 25 to 28 lbs. per quarter. It will be seen that the fattening of these animals commences immediately after weaning, and that it is continued, without interruption, until they are sent to market.

580. The best of the ewe hoggets are retained in the flock to take the place of the culled ewes, the remainder being sold in the neighbouring fairs, at remunerative prices.

581. The stock of cattle consists of 60 weanling calves, which are purchased in September at Hospital, Co. Limerick; and of fifty store animals—some two and a half, others three and a half years old—purchased in fairs nearer home in July and August. The most forward are fattened off in the stalls, and the remainder are sent in good condition to Belgard, and finished. The calves are fed on the after-grass until October, when they are brought into the straw-yard, divided into small lots, and supplied with soft turnips and hay. They get a run on the grass every day.

In winter they have pulped turnips, hay, and palm-nut meal. They are fed on the coarsest of the grass on the Coolarne farm during the following summer; in the succeeding winter they are sent to the upper farm, where there are sheds and coarse grass, and supplied with good oat straw. In spring they get a little hay. Some of these are fattened on the grass at Belgard, and the remainder in the stalls, and all sold off before they are three years old.

582. The yearly consumption of artificial food at Coolarne is 10 tons of palm-nut meal, 4 tons of linseed cake, 1 ton of locust-bean meal, 2 tons of Indian meal, 5 tons of malt combs, 10 cwt. of linseed meal, and 8 tons of oats, purchased in the neighbourhood.

583. Under the present system of management, Coolarne farm yields four times the rent of the land in its improved condition, or upwards of twenty times the rent in its original state. If left in grass, like many a tract of the same class of land, the gross produce would not exceed the present letting value. This fact cannot fail to afford matter for reflection to those who are desirous of promoting the agricultural prosperity of Ireland.

THE END.

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